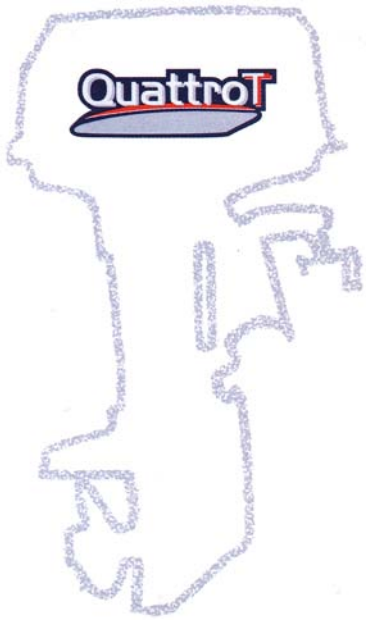
Grey Whale 200 EFI
Fin Whale 225 EFI

SERVICE MANUAL



SELVA Marine

NOTICE

This manual has been prepared by Selva primarily for use by Selva dealers and their trained mechanics when performing maintenance procedures and repairs to Selva equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Selva has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Selva dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

Important information

Particularly important information is distinguished in this manual by the following notations:

⚠ The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.

NOTE:

A NOTE provides key information to make procedures easier or clearer.

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How to use this manual

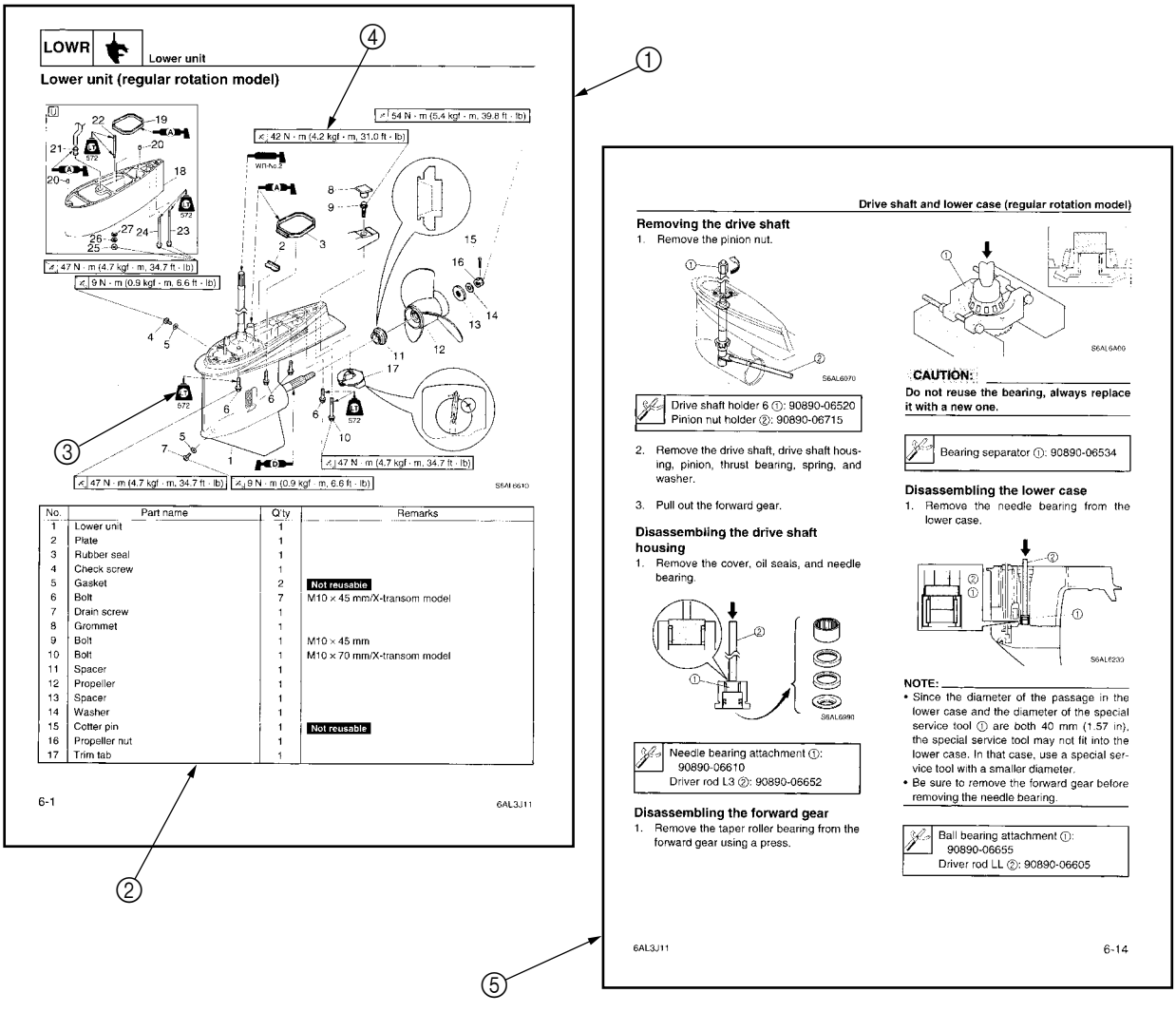
Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

- Parts are shown and detailed in an exploded diagram and are listed in the component list (see ① in the figure below for an example page).
- The component list consists of part names and quantities, as well as bolt and screw dimensions (see ② in the figure below).
- Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point (see ③ in the figure below).
- Tightening torque specifications are provided in the exploded diagrams (see ④ in the figure below for an example), and in the related detailed instructions. Some torque specifications are listed in stages as torque figures or angles in degrees.
- Separate procedures and illustrations are used to explain the details of removal, checking, and installation where necessary (see ⑤ in the figure below for an example page).

NOTE:

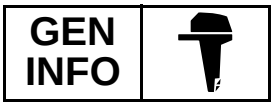
For troubleshooting procedures, see Chapter 9, “Troubleshooting.”



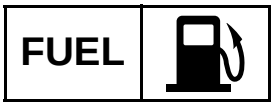
Symbol

The symbols below are designed to indicate the content of a chapter.

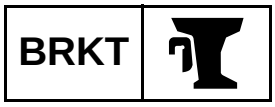
General information



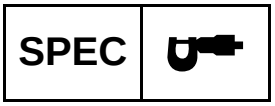
Fuel system



Bracket unit



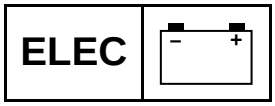
Specification



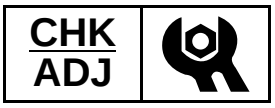
Power unit



Electrical system



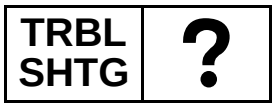
Periodic check and adjustment



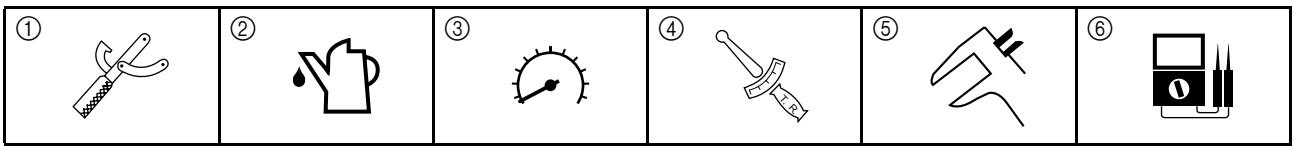
Lower unit



Troubleshooting

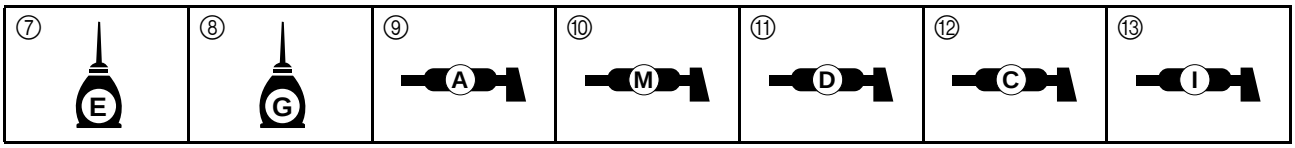


Symbols ① to ⑥ indicate specific data.



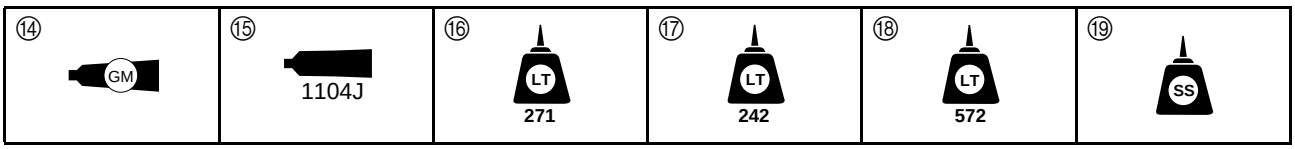
① Special service tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑬ in an exploded diagram or illustration indicate the grade of lubricant and the lubrication point.



⑦ Apply 4-stroke motor oil
⑧ Apply gear oil
⑨ Apply water resistant grease
⑩ Apply molybdenum disulfide grease
⑪ Apply corrosion resistant grease
⑫ Apply low temperature resistant grease
⑬ Apply injector grease

Symbols ⑭ to ⑲ in an exploded diagram or illustration indicate the type of sealant or locking agent and the application point.



⑭ Apply Gasket Maker
⑮ Apply ThreeBond 1104J
⑯ Apply LOCTITE 271 (red)
⑰ Apply LOCTITE 242 (blue)
⑱ Apply LOCTITE 572
⑲ Apply silicon sealant

Abbreviation

The following abbreviations are used in this service manual.

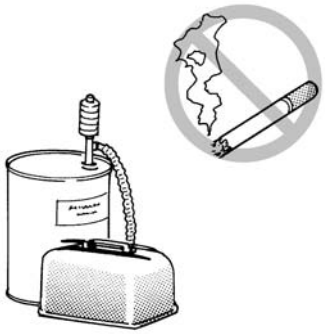
Abbreviation	Description
AFT	Aft end
API	American Petroleum Institute
BOW	Bow end
CCA	Cold Cranking Ampere
DES	Dual Engine System
ECM	Electronic Control Module
EN	European Norm (European standard)
EX	Exhaust
IEC	International Electrotechnical Commission
IN	Intake
LAN	Local Area Network
PCV	Pressure Control Valve
PORT	Port side
PTT	Power Trim and Tilt
SAE	Society of Automotive Engineers
STBD	Starboard side
TCI	Transistor controlled ignition
TDC	Top Dead Center
TPS	Throttle Position Sensor
UP	Upside
Ver.	Version
WD	Wiring diagram
YDIS	Diagnostic System

Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

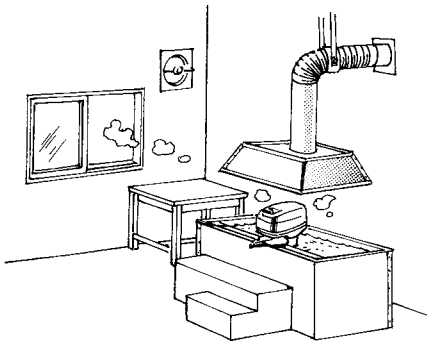
Fire prevention

Gasoline is highly flammable.
Keep gasoline and all flammable products away from heat, sparks, and open flames.


S69J1010

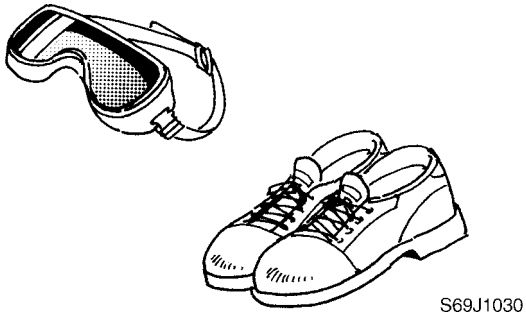
Ventilation

Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time. When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.


S69J1020

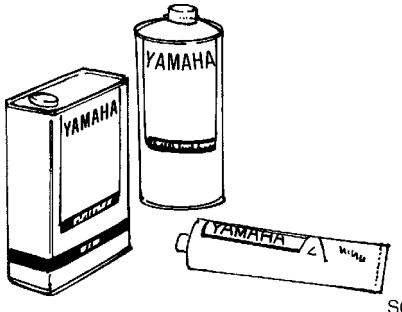
Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.


S69J1030

Part, lubricant, and sealant

Use only genuine Selva parts, lubricants, and sealants or those recommended by Selva, when servicing or repairing the outboard motor.



S69J1040

Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

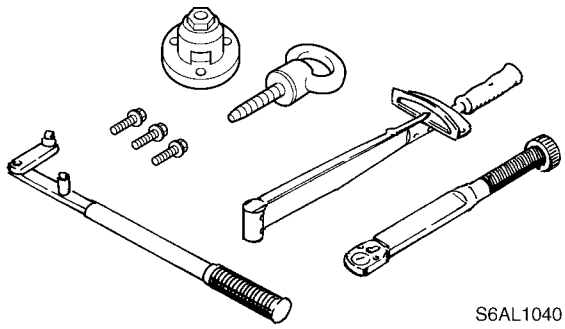
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

6. Keep a supply of clean, lint-free cloths for wiping up spills, etc.

Good working practice

Special service tool

Use the recommended special service tools to protect parts from damage. Use the right tool in the right manner—do not improvise.



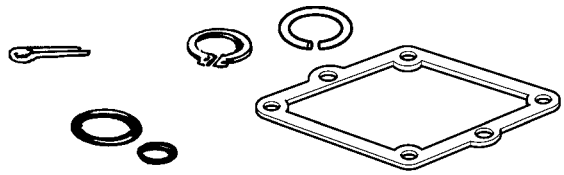
S6AL1040

Tightening torque

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

Non-reusable part

Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.

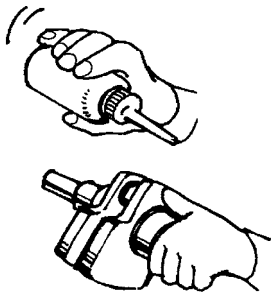


S69J1060

Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.

2. Apply engine oil to the contact surfaces of moving parts before assembly.



S69J1070

3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.

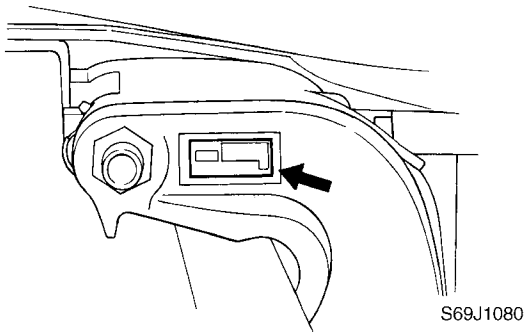
4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.

5. Check that moving parts operate normally after assembly.

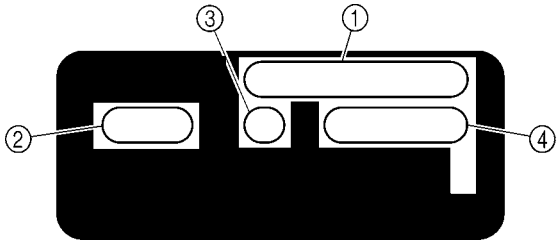
Identification

Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.



S69J1080

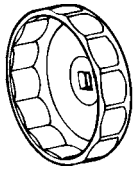


S6AL1D00

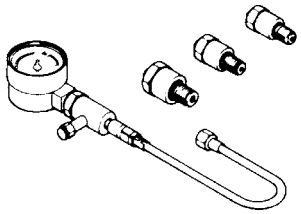
① Model name
② Approved model code
③ Transom height
④ Serial number

Model name	Approved model code	Starting serial No.
200 R	6AL	1000001–
200 L	6AM	1000001–
225 R	6AS	1000001–
225 L	6AT	1000001–

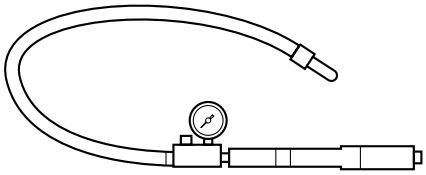
Special service tool



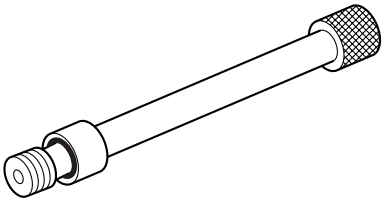
Oil filter wrench
90890-06830



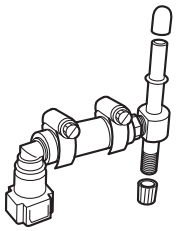
Compression gauge
90890-03160



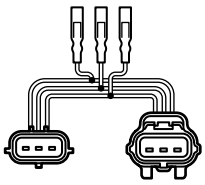
Leakage tester
90890-06840



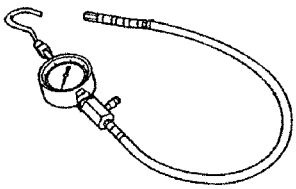
Compression gauge extension
90890-06563



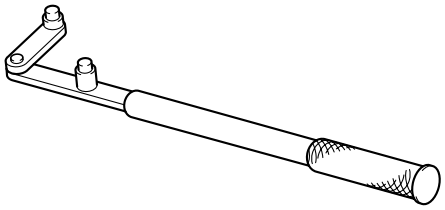
Fuel pressure gauge adapter B
90890-06942



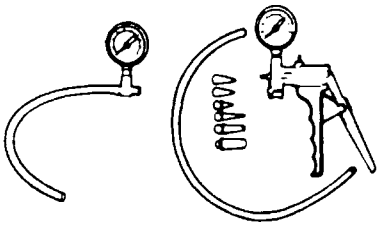
Test harness (3 pins)
90890-06869



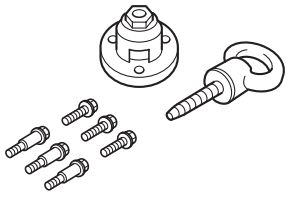
Fuel pressure gauge
90890-06786



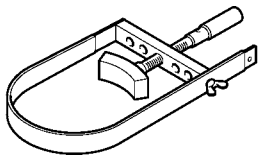
Flywheel holder
90890-06522



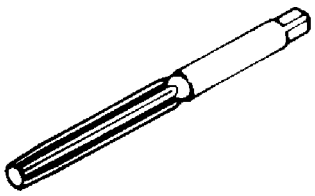
Vacuum/pressure pump gauge set
90890-06756



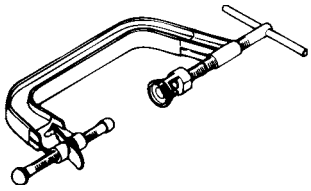
Flywheel puller
90890-06521



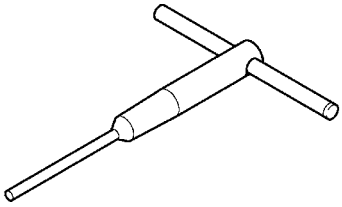
Sheave holder
90890-01701



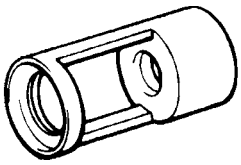
Valve guide reamer
90890-06804



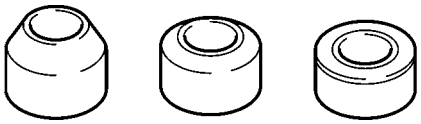
Valve spring compressor
90890-04019



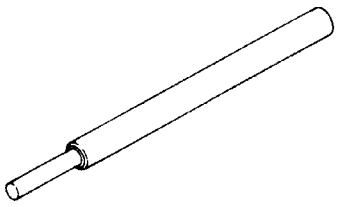
Valve seat cutter holder
90890-06316



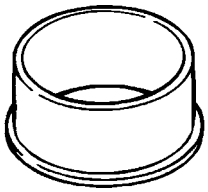
Valve spring compressor attachment
90890-06320



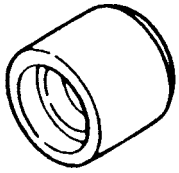
Valve seat cutter
90890-06324, 90890-06325, 90890-06326,
90890-06816, 90890-06817



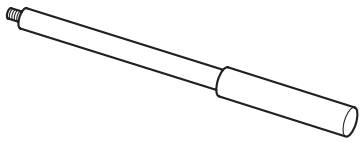
Valve guide remover/installer
90890-06801



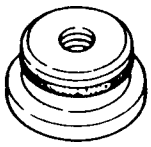
Bearing inner race attachment
90890-06640, 90890-06659, 90890-06661



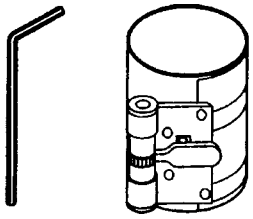
Valve guide installer
90890-06810



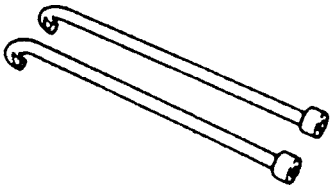
Driver rod L3
90890-06652



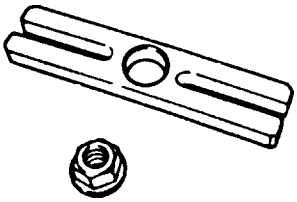
Needle bearing attachment
90890-06607, 90890-06610, 90890-06611, 90890-06612, 90890-06613, 90890-06653, 90890-06654



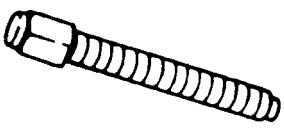
Piston ring compressor
90890-05158



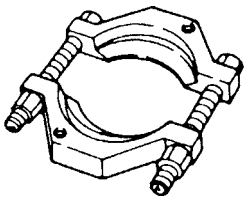
Bearing housing puller claw L
90890-06502



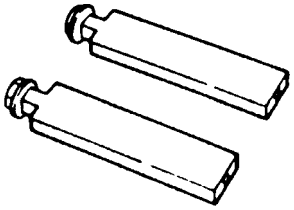
Stopper guide plate
90890-06501



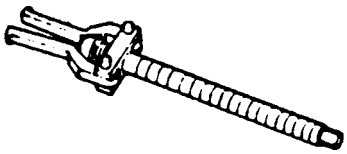
Center bolt
90890-06504



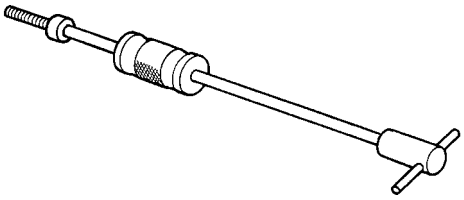
Bearing separator
90890-06534



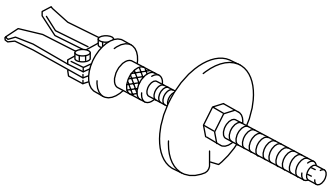
Stopper guide stand
90890-06538



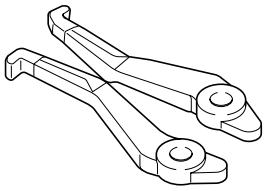
Bearing puller assembly
90890-06535



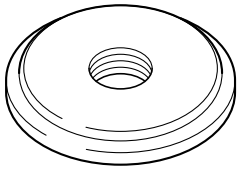
Slide hammer
90890-06531



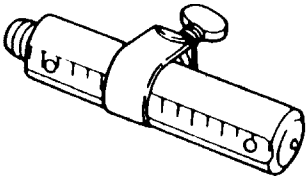
Bearing outer race puller assembly
90890-06523



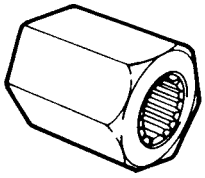
Outer race puller claw A
90890-06532



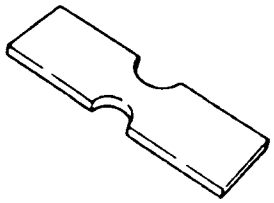
Bearing outer race attachment
90890-06622, 90890-06628, 90890-06658



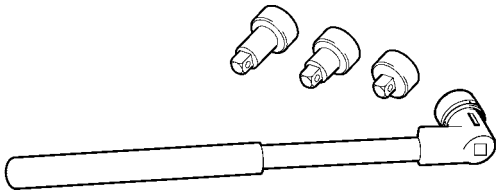
Driver rod SS
90890-06604



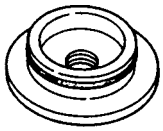
Drive shaft holder 6
90890-06520



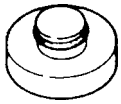
Bearing depth plate
90890-06603



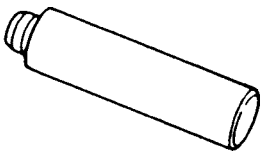
Pinion nut holder
90890-06715



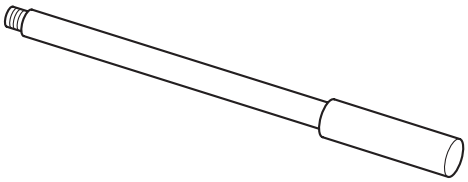
Ball bearing attachment
90890-06656, 90890-06657



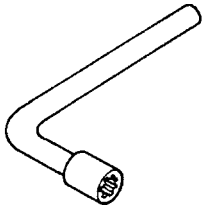
Ball bearing attachment
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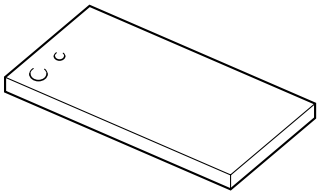
Driver rod LS
90890-06606



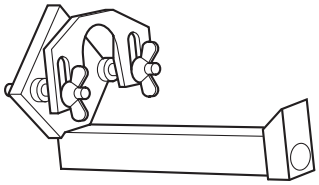
Driver rod LL
90890-06605



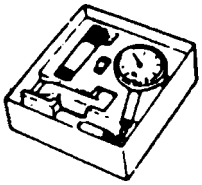
Shift rod push arm
90890-06052



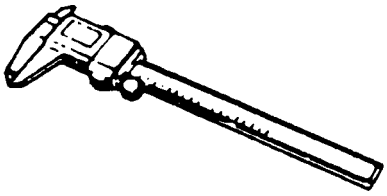
Magnet base plate
90890-07003



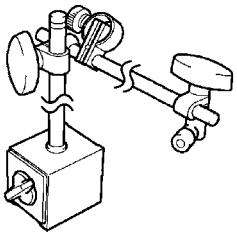
Pinion height gauge
90890-06710



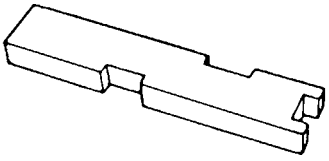
Dial gauge set
90890-01252



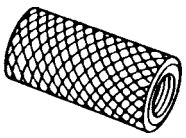
Digital caliper
90890-06704



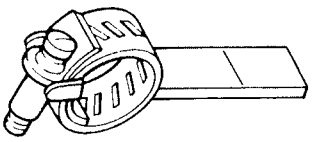
Magnet base B
90890-06844



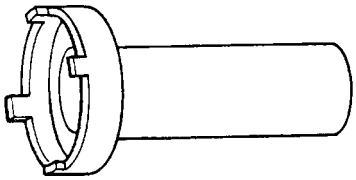
Shimming plate
90890-06701



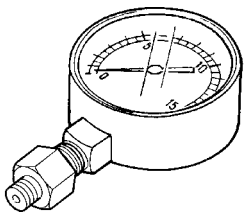
Puller head
90890-06514



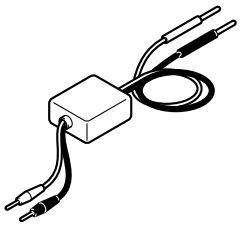
Backlash indicator
90890-06706



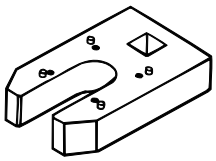
Ring nut wrench
90890-06578



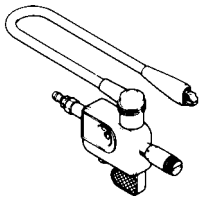
PTT oil pressure gauge assembly
90890-06580



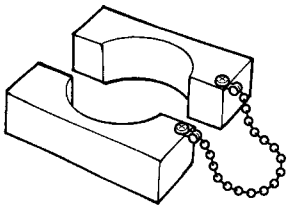
Peak voltage adapter B
90890-03172



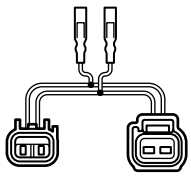
Cylinder-end screw wrench
90890-06568



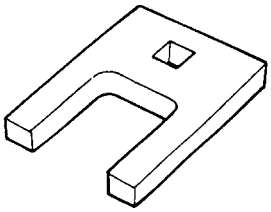
Ignition tester
90890-06754



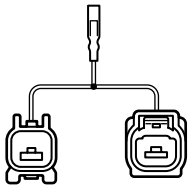
PTT piston vice attachment
90890-06572



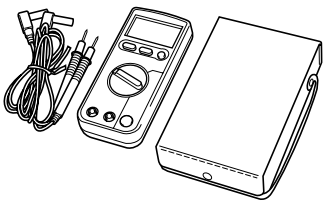
Test harness (2 pins)
90890-06867



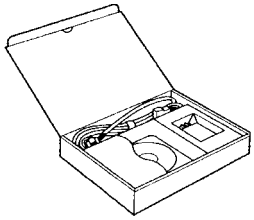
Tilt rod wrench
90890-06569



Test harness (1 pin)
90890-06888



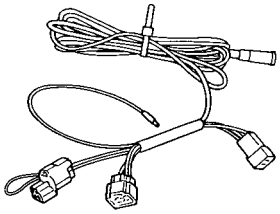
Digital circuit tester
90890-03174



Selva diagnostic system
60V-85300-05-00



Selva diagnostic system (Ver. 1.32)
60V-WS853-05



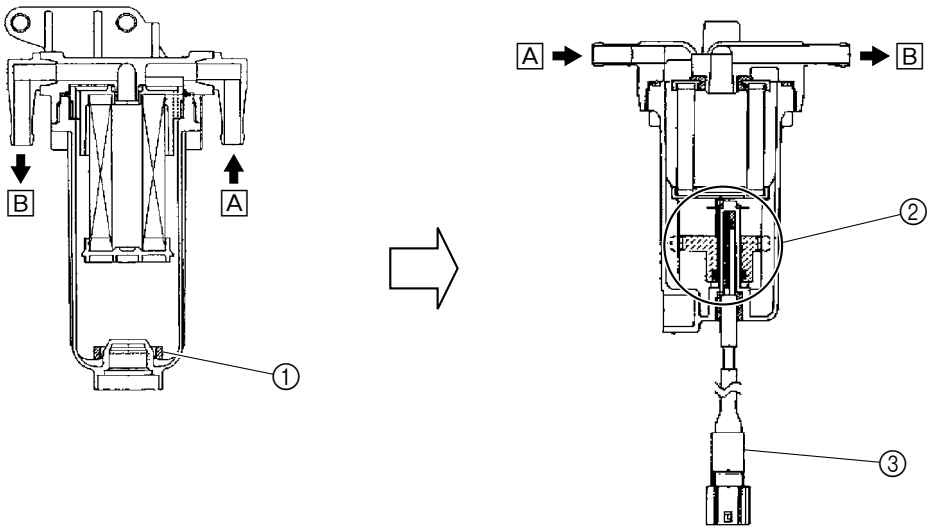
Diagnostic flash indicator B
90890-06865

Feature and benefit

Water separator

For the 2007 models, a fuel filter assembly with a water detection switch has been adopted on the fuel line as a system to improve engine protection.
The water detection warnings are given only if the fuel filter assembly with a water detection switch is connected to the 6Y8 Multifunction Meter.
The 6Y8 Multifunction Meter is a meter designed to be used in a local area network (LAN).

2006 model F(L)250A P/N: 6P2-24409-00 Water accumulation capacity: 55 ml Fuel filter: 40 µm (Paper, Yellow)	2007 model F(L)200C, F(L)225B, F(L)250A P/N: 6P2-24409-10 Water accumulation capacity: 30 ml Fuel filter: 10 µm (Paper, Green)



S6AL1060

① Float (red)
② Water detection switch (black)
③ 2-pin coupler (blue)

A In
B Out

Interchangeability The new and previous parts are not interchangeable. Previous parts → previous engine New parts → new engine

When the water detection switch is on, the water detection warnings are given according to the conditions as listed in the following table.

Warning condition table

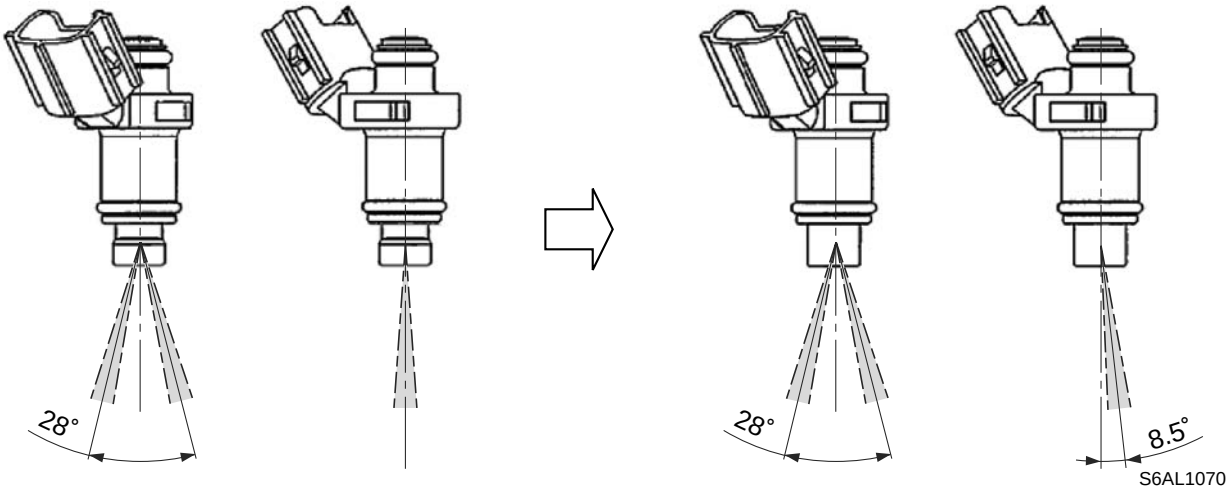
Shift position	Buzzer	Indicator
Neutral	Yes	Yes
Forward/Reverse	No	Yes

Injector

The injector for the 2007 models was improved in order to reduce the amount of soot after combustion compared to the injector used for the 2006 model F(L)250A.
Due to the change in the injector spray angle, the ECM fuel injection mapping was also changed. Therefore, be sure to use the 2007 model injector together with the 2007 model ECMs.

2006 model F(L)250A

2007 model F(L)200C, F(L)225B, F(L)250A



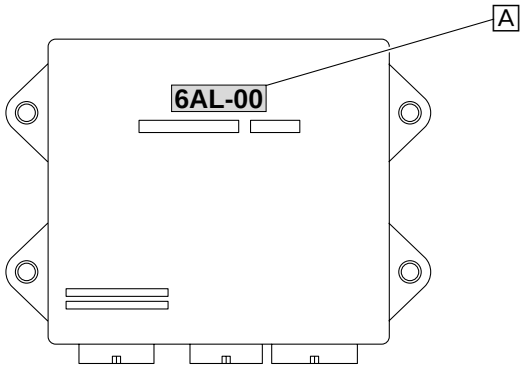
Identification table

Injector body color	
2006 model	2007 model
Light gray	Violet
6P2-13761-00	6P2-13761-10

Interchangeability
The new and previous parts are not interchangeable.
Previous parts → previous engine
New parts → new engine

ECM

The ECM changes due to the yearly modifications are listed in the following table according to the model for the F(L)200C, F(L)225B, F(L)250A.
Due to the change in the injector spray angle, the ECM fuel injection mapping was also changed.



S6AL1080

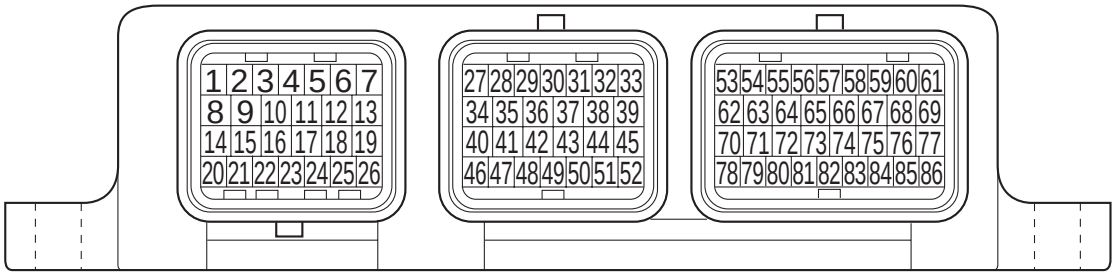
A ECM identification

Identification table

Model	ECM identification	Description
F(L)200C	6AL-00	2007 model
F(L)225B	6AS-00	2007 model
F(L)250A	6P2-02	2006 model
	6P2-03	2007 model

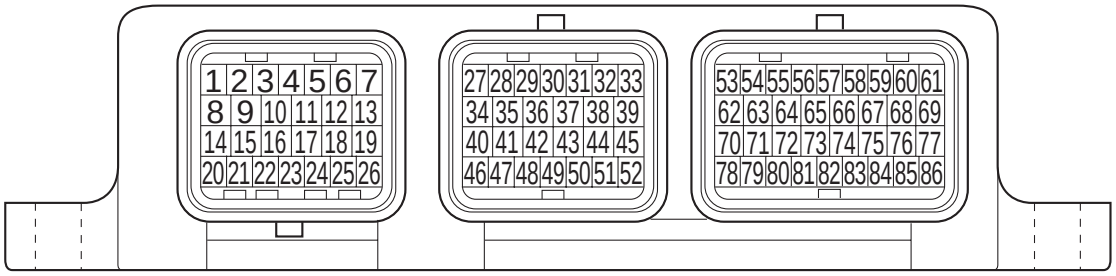
Interchangeability
The new and previous parts are not interchangeable.
Previous parts → previous engine
New parts → new engine

ECM coupler layout (F(L)200C, F(L)225B)



No.	Connecting part	Color code
1	Cam position sensor (STBD IN)	White/black
2	Cam position sensor (PORT IN)	White/green
3	Cam position sensor (PORT EX)	White/blue
4		
5	Water detection switch	Blue/white
6	Shift cut switch	Blue/yellow
7	Main relay	Yellow/green
8	Knock sensor	Green
9		
10		
11		
12	Neutral switch	Blue/green
13	Engine start switch	Yellow
14		
15	Crank position sensor ground	Black
16	Crank position sensor	White/black
17	Engine temperature sensor	Black/yellow
18	Sensor ground	Black
19	Trim sensor (LAN)	Pink
20	LAN communication (H)	White
21	LAN communication (L)	Blue
22		
23	Intake air temperature sensor	Black/yellow
24		
25		
26		
27	Battery power source	Red/yellow

No.	Connecting part	Color code
28	YDIS	White/black
29		
30		
31	Accelerator position sensor 1 (main)	Pink/white
32		
33		
34	Battery power source	Red/yellow
35		
36	Intake air pressure sensor	Pink/green
37	Oil pressure sensor	Pink/white
38	Accelerator position sensor 2 (sub)	Pink
39		
40	Accelerator position sensor 2 ground (sub)	Black
41	Accelerator position sensor 1 ground (main)	Black
42	Cooling water pressure sensor (optional)	Blue/black
43	Speed sensor (optional)	Blue
44	Accelerator position sensor 2 power source (sub)	Orange
45	TPS 1 (main)	Pink
46	Unit ground	Black
47	TPS ground	Black
48	Sensor power source	Orange
49	Accelerator position sensor 1 power source (main)	Orange
50	TPS 2 (sub)	Pink/white

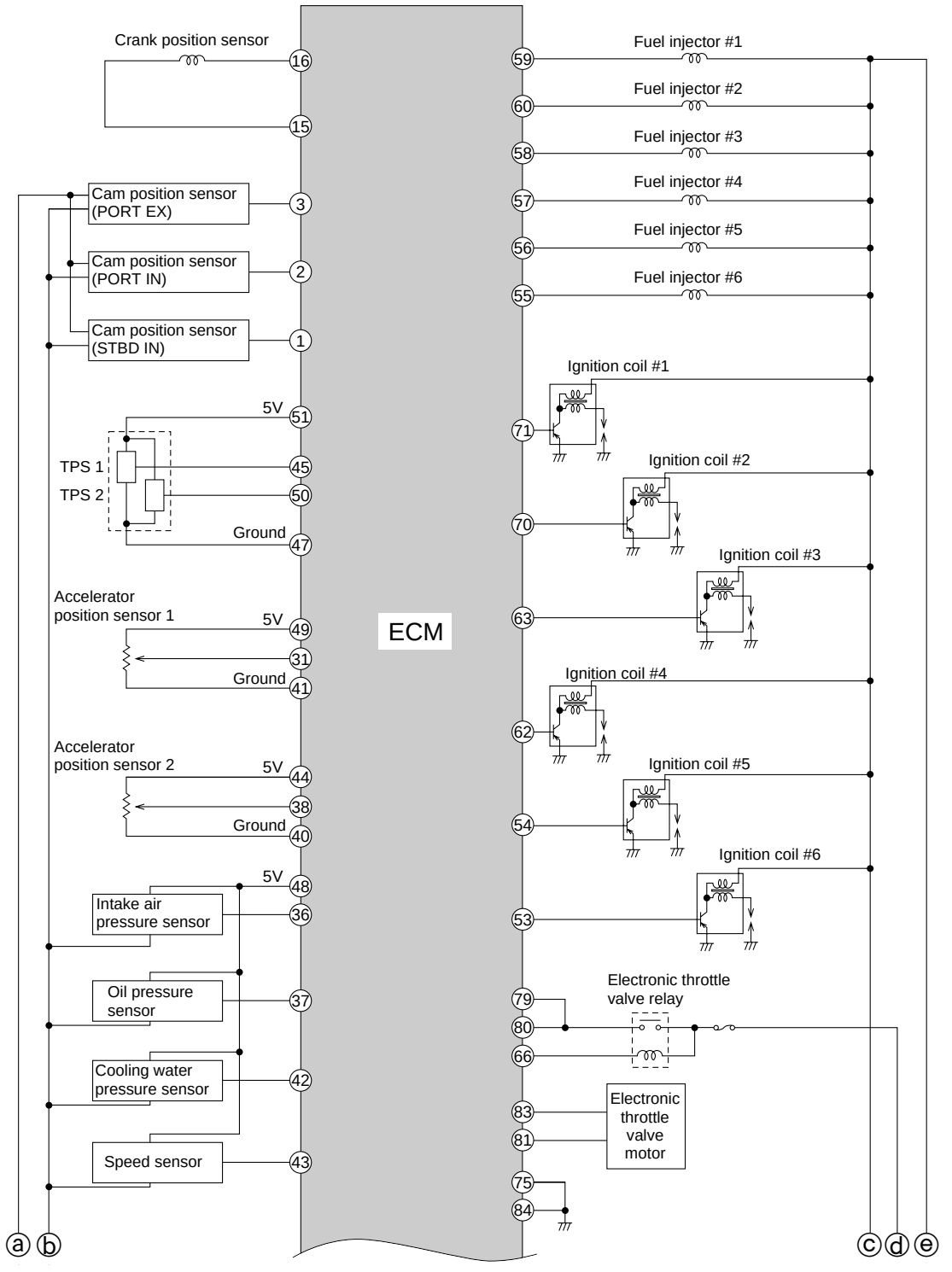


No.	Connecting part	Color code
51	TPS power source	Orange
52	Thermoswitch	Pink
53	Ignition coil #6	Black/brown
54	Ignition coil #5	Black/blue
55	Fuel injector #6	Purple/white
56	Fuel injector #5	Purple/blue
57	Fuel injector #4	Purple/green
58	Fuel injector #3	Purple/yellow
59	Fuel injector #1	Purple/red
60	Fuel injector #2	Purple/black
61	Low-pressure fuel pump	Blue/white
62	Ignition coil #4	Black/green
63	Ignition coil #3	Black/yellow
64	Tachometer	Green
65	High-pressure fuel pump relay	Blue/red
66	Electronic throttle valve relay	Yellow
67	Buzzer	Pink
68	ECM ground	Black
69	ECM ground	Black
70	Ignition coil #2	Black/white
71	Ignition coil #1	Black/orange
72	Low oil pressure warning indicator	Pink/white
73	Overheat warning indicator	Pink/black
74	Diagnostic flash indicator B	Blue/white
75	Electronic throttle valve ground	Black
76	ECM ground	Black
77	Oil control valve (PORT)	Purple

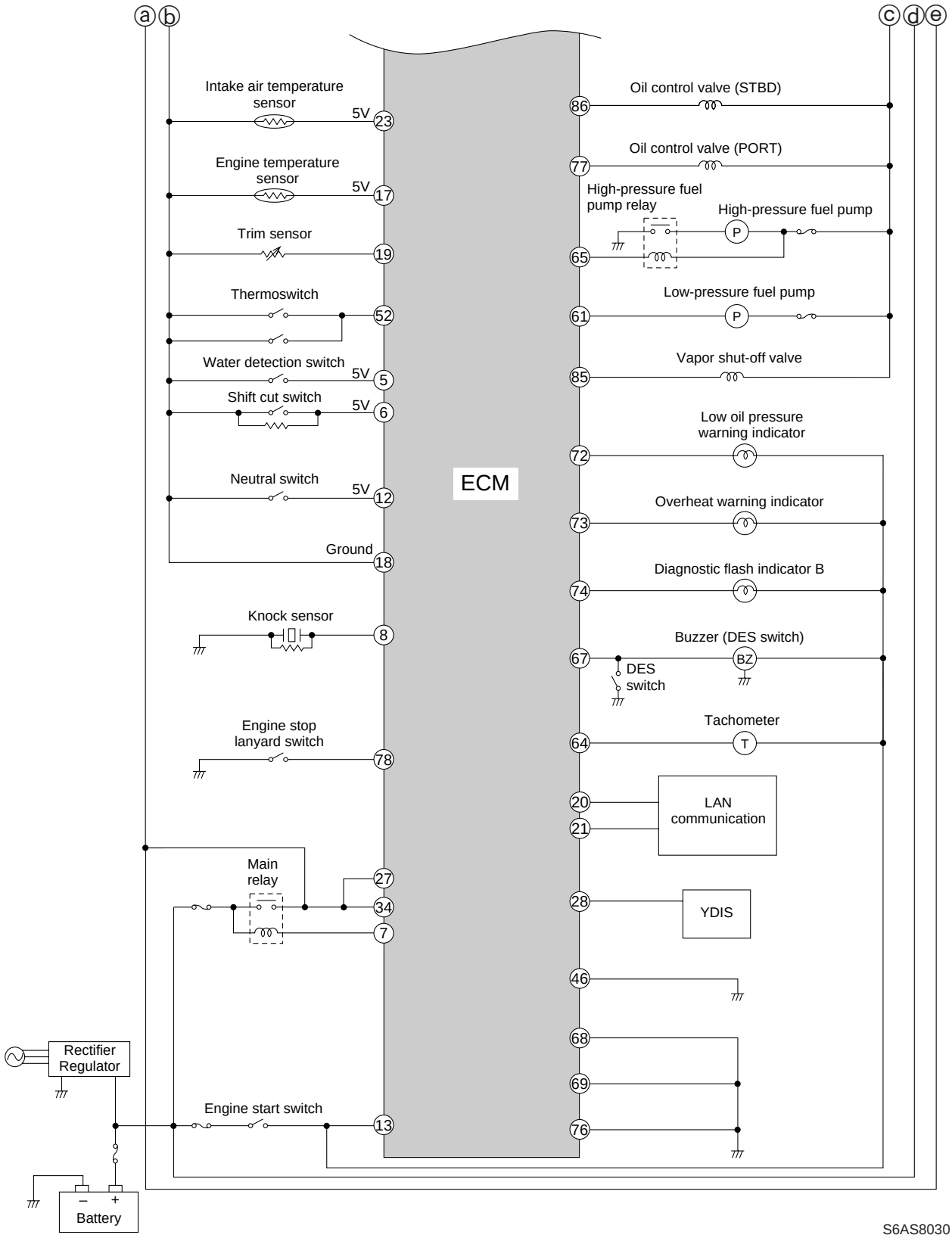
No.	Connecting part	Color code
78	Engine stop lanyard switch	White
79	Electronic throttle valve power source	Red/green
80	Electronic throttle valve power source	Red/green
81	Electronic throttle valve motor	Green/black
82		
83	Electronic throttle valve motor	Green/red
84	Electronic throttle valve ground	Black
85	Vapor shut-off valve	Green/black
86	Oil control valve (STBD)	Purple

Circuit diagram (F(L)200C, F(L)225B)

NOTE:
The circled numbers in the illustration indicate the ECM terminal numbers.



S6P21130C

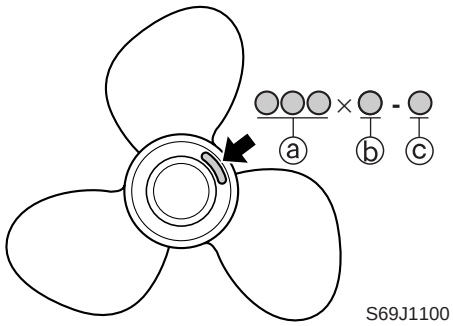

a b c d e
Intake air temperature sensor
5V
23
Engine temperature sensor
5V
17
Trim sensor
19
Thermoswitch
52
Water detection switch
5V
5
Shift cut switch
5V
6
Neutral switch
5V
12
Ground
18
Knock sensor
8
Engine stop lanyard switch
78
Main relay
27
34
7
Rectifier Regulator
Engine start switch
13
Battery
ECM
Oil control valve (STBD)
86
Oil control valve (PORT)
77
High-pressure fuel pump relay
High-pressure fuel pump
P
65
Low-pressure fuel pump
61
Vapor shut-off valve
85
Low oil pressure warning indicator
72
Overheat warning indicator
73
Diagnostic flash indicator B
74
Buzzer (DES switch)
67
BZ
DES switch
Tachometer
64
T
20
21
LAN communication
28
YDIS
46
68
69
76
S6AS8030

Propeller selection

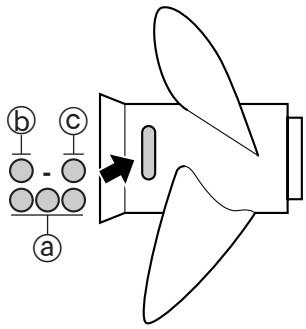
The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller boss end, on the side of the propeller boss.



S69J1100



S6P21100

ⓐ Propeller diameter (in inches)
ⓑ Propeller pitch (in inches)
ⓒ Propeller type (propeller mark)

Selection

When the engine speed is at the full throttle operating range (5,000–6,000 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

Regular rotation model

Propeller size (in)	Material
13 3/4 × 17 - M2	Stainless
13 3/4 × 19 - M2	
13 3/4 × 21 - M	
14 1/2 × 15 - M	
14 1/2 × 19 - T	
14 1/2 × 21 - T	
14 1/2 × 23 - M	
14 7/8 × 21 - M	
15 × 17 - T	
15 × 21 - T	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 1/4 × 19 - M	
15 1/4 × 19 - T	
15 1/2 × 17 - T	

Counter rotation model

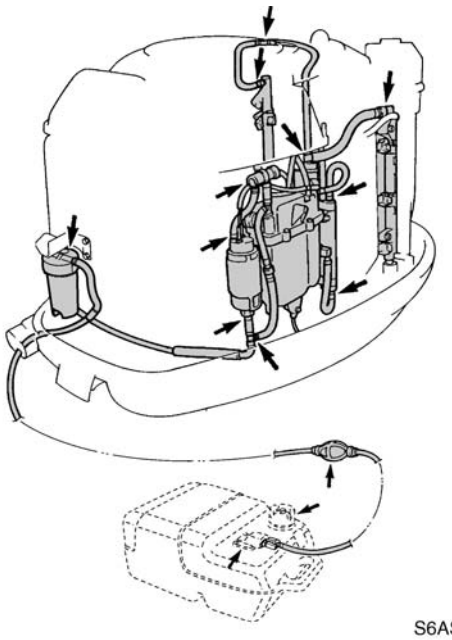
Propeller size (in)	Material
13 3/4 × 17 - ML1	Stainless
13 3/4 × 19 - ML1	
13 3/4 × 21 - ML	
14 1/2 × 19 - TL	
14 1/2 × 21 - TL	
14 1/2 × 23 - ML	
14 7/8 × 21 - ML	
15 × 17 - TL	
15 × 21 - TL	
15 1/4 × 15 - ML	
15 1/4 × 17 - ML	
15 1/4 × 19 - ML	
15 1/4 × 19 - TL	
15 1/2 × 17 - TL	

Predelivery check

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.



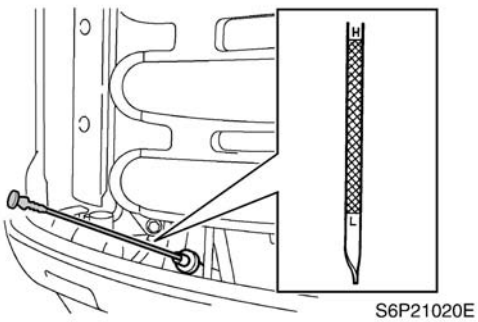
S6AS1010

CAUTION:

This is a 4-stroke engine. Never use premixed fuel or 2-stroke outboard motor oil.

Checking the engine oil level

1. Check the engine oil level.



S6P21020E

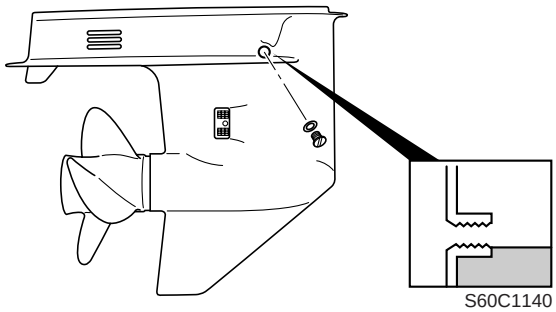
NOTE:

If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, or 10W-40
Engine oil quantity:
Without oil filter replacement:
5.6 L (5.92 US qt, 4.93 Imp qt)

Checking the gear oil level

1. Check the gear oil level.



S60C1140

Checking the battery

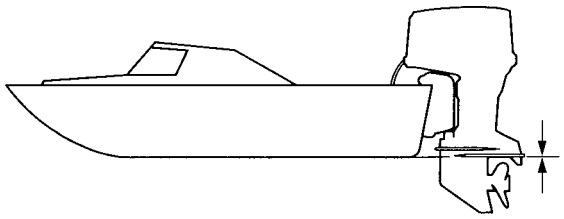
1. Check the battery capacity, electrolyte level, and specific gravity of the electrolyte.

Recommended battery capacity:
CCA/EN: 711 A
20HR/IEC: 100 Ah
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

2. Check that the positive and negative battery cables are securely connected.

Checking the outboard motor mounting height

1. Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced. Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.



S69J1160

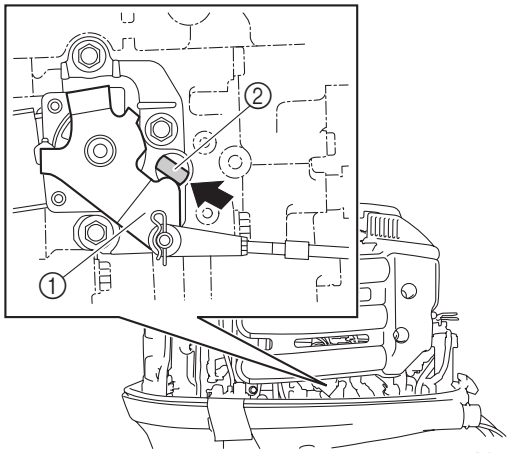
NOTE:
The optimum mounting height is affected by the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

2. Check that the clamp brackets are secured with the clamp bolts.

Checking the remote control cable

1. Set the remote control lever to the neutral position and fully close the throttle lever.

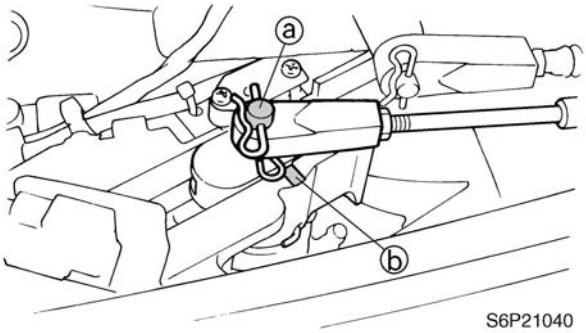
2. Check that the accelerator lever ① contacts the fully closed stopper ②.



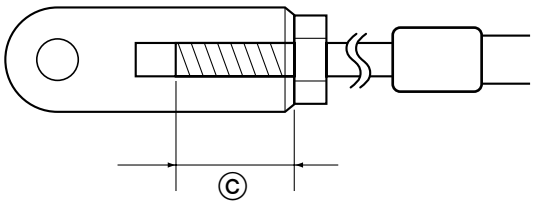
S6P21030

NOTE:
To adjust the throttle cable, see Chapter 3, “Adjusting the throttle cable.”

3. Check that the center of the set pin ⓐ is aligned with the alignment mark ⓑ on the bracket.



S6P21040



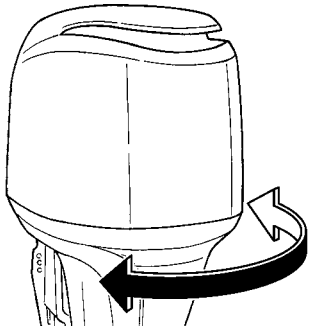
S6AL3120

⚠ WARNING

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

Checking the steering system

1. Check that the steering operates smoothly.

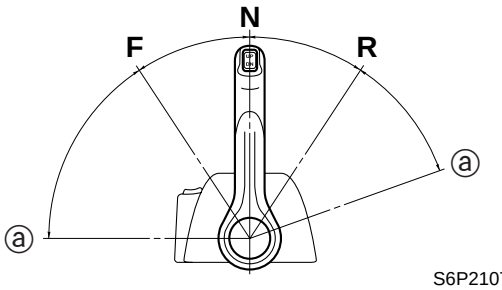

S69J1200

2. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the gear shift and throttle operation

1. Check that the gear shift operates smoothly when the remote control lever is shifted from the neutral position to forward or reverse.

2. Check that the throttle operates smoothly when the remote control lever is shifted from forward or reverse to the fully open position ⓐ.



S6P21070

Checking the PTT system

1. Check that the outboard motor tilts up and down smoothly when operating the PTT unit.

2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.

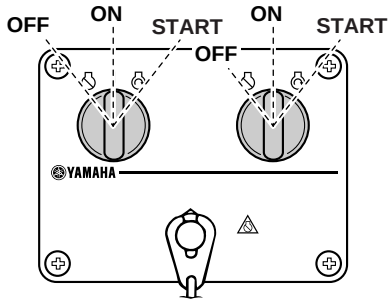
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.

4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the engine start switch and engine stop lanyard switch

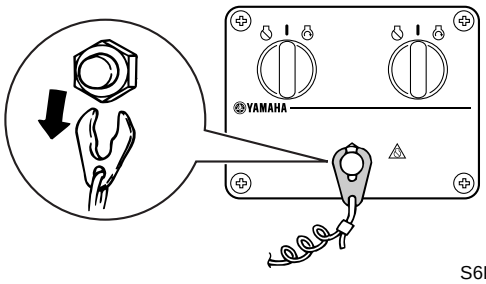
1. Check that the engine starts when the engine start switch is turned to “START.”

2. Check that the engine turns off when the engine start switch is turned to “OFF.”



S6P21080

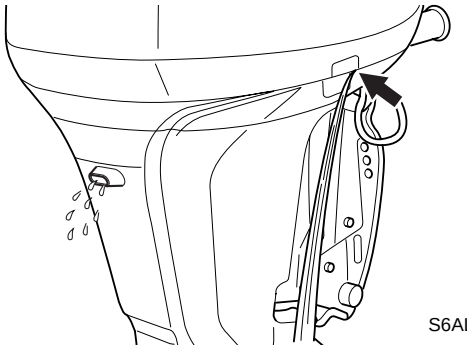
3. Check that the engine turns off when the engine stop lanyard is pulled from the engine stop lanyard switch.



S6P21090E

Checking the cooling water pilot hole

1. Start the engine, check that cooling water is discharged from the cooling water pilot hole.



S6AL3180

Test run

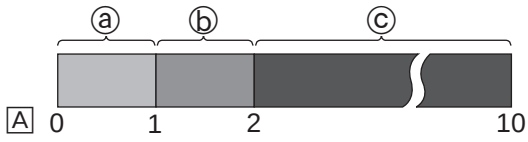
1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 hour at 2,000 r/min or at half throttle, then for another hour at 3,000 r/min or at 3/4 throttle.
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

NOTE:
The test run is part of the break-in operation.

Break-in

During the test run, perform the break-in operation in the following 3 stages.

1. 1 hour ⓐ at 2,000 r/min or at approximately half throttle
2. 1 hour ⓑ at 3,000 r/min or 3/4 throttle and 1 minute out of every 10 at full throttle
3. 8 hours ⓒ with the engine at any speed. However, avoid operating at full throttle for more than 5 minutes at a time.



S69J1240

A Hour

After test run

1. Check for water in the gear oil.
2. Check for fuel leakage in the cowling.
3. Flush the cooling water passage with fresh water using the flushing kit and with the engine running at idle.

CAUTION:
Be sure to supply sufficient water and water pressure when flushing the cooling water passage. If sufficient water and sufficient water pressure are not supplied, the engine can overheat.

Specification

General specification 2-1

Maintenance specification 2-3
Power unit 2-3
Fuel system 2-6
PTT unit 2-7
Lower unit 2-7
Electrical 2-8
Dimension 2-12

Tightening torque 2-14
Specified torque 2-14
General torque 2-17

General specification

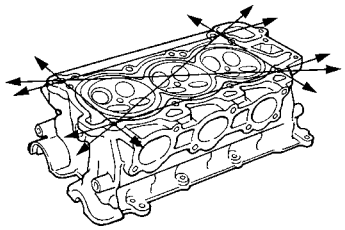
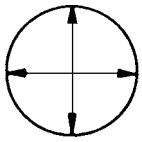
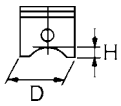
Item	Unit	Model			
		200 R	200 L	225 R	225 L
Dimension					
Overall length	mm (in)	892 (35.1)			
Overall width	mm (in)	634 (25.0)			
Overall height					
(X)	mm (in)	1,829 (72.0)			
(U)	mm (in)	—	—	1,956 (77.0)	—
Boat transom height					
(X)	mm (in)	635 (25.0)			
(U)	mm (in)	—	—	762 (30.0)	—
Weight					
(with stainless propeller)					
(X)	kg (lb)	278.0 (613)			
(U)	kg (lb)	—	—	284.0 (626)	—
Performance					
Maximum output	kW (hp)	147.1 (200) at 5,500 r/min		165.5 (225) at 5,500 r/min	
Full throttle operating range	r/min	5,000–6,000			
Maximum fuel consumption	L (US gal, Imp gal)/hr	68.0 (18.0, 15.0) at 6,000 r/min		78.0 (20.6, 17.2) at 6,000 r/min	
Engine idle speed	r/min	600–700			
Power unit					
Type		4-stroke, DOHC			
Cylinder quantity		V6			
Total displacement	cm^3 (cu. in)	3,352 (204.5)			
Bore × stroke	mm (in)	94.0 × 80.5 (3.70 × 3.17)			
Compression ratio		9.9			
Control system		Remote control			
Starting system		Electric			
Fuel system		Fuel injection			
Ignition control system		TCI			
Advance type		Micro computer			
Maximum generator output	V, A	12, 46			
Spark plug		LFR6A-11 (NGK)			
Firing order		1–2–3–4–5–6 (Normal operation)			
Cooling system		Water			
Exhaust system		Propeller boss			
Lubrication system		Wet sump			

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Fuel and oil					
Fuel type		Regular unleaded gasoline			
Engine oil		4-stroke motor oil			
Engine oil grade(*1)	API	SE, SF, SG, SH, SJ, or SL			
	SAE	5W-30, 10W-30, or 10W-40			
Engine oil quantity					
(without oil filter replacement)	L (US qt, Imp qt)	5.6 (5.92, 4.93)			
(with oil filter replacement)	L (US qt, Imp qt)	5.8 (6.13, 5.10)			
Gear oil type		Hypoid gear oil			
Gear oil grade(*2)	API	GL-4			
	SAE	90			
Gear oil quantity	cm^3 (US oz, Imp oz)	1,150 (38.9, 40.6)	1,000 (33.8, 35.3)	1,150 (38.9, 40.6)	1,000 (33.8, 35.3)
Bracket unit					
Trim angle (at 12° boat transom)	Degree	–3 to 16			
Tilt-up angle	Degree	70			
Steering angle	Degree	32 + 32			
Drive unit					
Gear shift positions		F-N-R			
Gear ratio		2.00 (30/15)			
Reduction gear type		Spiral bevel gear			
Clutch type		Dog clutch			
Propeller shaft type		Spline			
Propeller direction (rear view)		Clockwise	Counter-clockwise	Clockwise	Counter-clockwise
Propeller mark		T, M	TL, ML	T, M	TL, ML
Electrical					
Battery minimum capacity					
CCA/EN	A	711			
20HR/IEC	Ah	100			
Electrolyte specific gravity					
at 20 °C (68 °F)		1.280			

(*1) If the recommended engine oil grades are not available, use engine oil with an SAE classification of 15W-40, 20W-40, or 20W-50 and an API classification of SH, SJ, or SL.
(*2) Meeting both API and SAE requirements

Maintenance specification

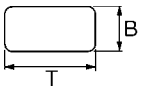
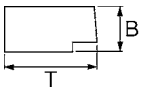
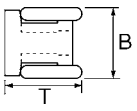
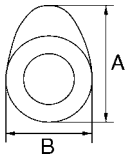
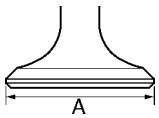
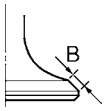
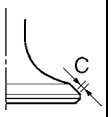
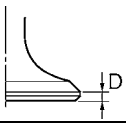
Power unit

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Power unit					
Minimum compression pressure(*1)	kPa (kgf/cm^2, psi)	740 (7.4, 107.3)			
Oil pressure(*2)	kPa (kgf/cm^2, psi)	600 (6.0, 87.0) at 600–900 r/min			
Timing belt					
Timing belt installation height	mm (in)	2.0 (0.08)			
Timing belt-to-timing belt guide clearance	mm (in)	1.0 ± 0.5 (0.04 ± 0.02)			
Cylinder head					
Warpage limit  (lines indicate straightedge position)	mm (in)	0.1 (0.0039)			
Camshaft cap inside diameter	mm (in)	25.000–25.021 (0.9843–0.9851)			
Cylinder					
Bore size 	mm (in)	94.000–94.017 (3.7008–3.7014)			
Piston					
Piston diameter (D) 	mm (in)	93.921–93.941 (3.6977–3.6985)			
Measuring point (H)	mm (in)	5.0 (0.20)			
Piston clearance(*3)	mm (in)	0.075–0.080 (0.0030–0.0031)			
Piston pin boss bore	mm (in)	21.017–21.031 (0.8274–0.8280)			
Piston ring groove					
Top ring	mm (in)	1.23–1.25 (0.048–0.049)			
Second ring	mm (in)	1.22–1.24 (0.048–0.049)			
Oil ring	mm (in)	2.51–2.53 (0.099–0.100)			
Piston pin					
Outside diameter	mm (in)	20.995–21.000 (0.8266–0.8268)			

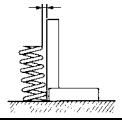
(*1) Measuring conditions:
Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.
The figures are for reference only.

(*2) For details of the checking method, see Chapter 5, “Checking the oil pressure.”
The figures are for reference only.

(*3) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Piston ring					
Top ring					
Dimension B 	mm (in)	1.17–1.19 (0.046–0.047)			
Dimension T	mm (in)	2.80–3.00 (0.110–0.118)			
End gap(*1)	mm (in)	0.15–0.30 (0.006–0.012)			
Side clearance	mm (in)	0.04–0.08 (0.002–0.003)			
2nd piston ring					
Dimension B 	mm (in)	1.17–1.19 (0.046–0.047)			
Dimension T	mm (in)	3.70–3.90 (0.146–0.154)			
End gap(*1)	mm (in)	0.30–0.45 (0.012–0.018)			
Side clearance	mm (in)	0.03–0.07 (0.001–0.003)			
Oil ring					
Dimension B 	mm (in)	2.40–2.47 (0.094–0.097)			
Dimension T	mm (in)	2.30–2.70 (0.091–0.106)			
End gap(*1)	mm (in)	0.15–0.60 (0.006–0.024)			
Side clearance	mm (in)	0.04–0.13 (0.002–0.005)			
Camshaft					
Intake (A) 	mm (in)	46.30–46.40 (1.823–1.827)			
Exhaust (A)	mm (in)	45.35–45.45 (1.785–1.789)			
Intake and exhaust (B)	mm (in)	35.95–36.05 (1.415–1.419)			
Camshaft journal diameter	mm (in)	24.96–24.98 (0.9826–0.9834)			
Camshaft runout limit	mm (in)	0.015 (0.0006)			
Valve					
Valve clearance (cold)					
Intake	mm (in)	0.20 ± 0.03 (0.008 ± 0.001)			
Exhaust	mm (in)	0.34 ± 0.03 (0.013 ± 0.001)			
Head diameter (A) 					
Intake	mm (in)	36.4–36.6 (1.43–1.44)			
Exhaust	mm (in)	31.4–31.6 (1.24–1.24)			
Face width (B) 					
Intake	mm (in)	2.35–2.78 (0.092–0.110)			
Exhaust	mm (in)	2.13–3.30 (0.084–0.130)			
Seat contact width (C) 					
Intake	mm (in)	1.10–1.40 (0.043–0.055)			
Exhaust	mm (in)	1.40–1.70 (0.055–0.067)			
Margin thickness (D) 					
Intake	mm (in)	0.50–0.90 (0.020–0.035)			
Exhaust	mm (in)	0.90–1.30 (0.035–0.051)			

(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Stem diameter					
Intake	mm (in)	5.477–5.492 (0.2156–0.2162)			
Exhaust	mm (in)	5.464–5.479 (0.2151–0.2157)			
Stem runout limit	mm (in)	0.01 (0.0004)			
Guide inside diameter					
Intake and exhaust	mm (in)	5.504–5.522 (0.2167–0.2174)			
Stem-to-guide clearance					
Intake	mm (in)	0.012–0.045 (0.0005–0.0018)			
Exhaust	mm (in)	0.025–0.058 (0.0010–0.0023)			
Guide installation position	mm (in)	13.8 ± 0.2 (0.5 ± 0.01)			
Valve spring					
Free length 	mm (in)	44.2 (1.74)			
Tilt limit	mm (in)	1.2 (0.05)			
Valve lifter					
Valve lifter outside diameter	mm (in)	32.982–32.997 (1.2985–1.2991)			
Valve lifter-to-cylinder head clearance	mm (in)	0.020–0.055 (0.0008–0.0022)			
Valve shim					
Valve shim thickness (in 0.020 mm increments)	mm (in)	2.320–2.960 (0.0913–0.1165)			
Connecting rod					
Small end inside diameter	mm (in)	21.017–21.031 (0.8274–0.8280)			
Big end inside diameter	mm (in)	53.015–53.035 (2.0872–2.0880)			
Big end side clearance(*1)	mm (in)	0.15–0.30 (0.006–0.012)			
Crankpin oil clearance	mm (in)	0.028–0.066 (0.0011–0.0026)			
Big end bearing thickness					
Yellow	mm (in)	1.492–1.496 (0.0587–0.0589)			
Green	mm (in)	1.496–1.500 (0.0589–0.0591)			
Blue	mm (in)	1.500–1.504 (0.0591–0.0592)			
Crankshaft					
Crankshaft journal diameter	mm (in)	62.968–62.992 (2.4791–2.4800)			
Crankpin diameter	mm (in)	49.976–50.000 (1.9676–1.9685)			
Crankpin width	mm (in)	21.50–21.55 (0.8465–0.8484)			
Crankshaft runout limit	mm (in)	0.03 (0.0012)			

(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Crankcase					
Crankshaft journal oil clearance	mm (in)	0.025–0.050 (0.0010–0.0020)			
Upper crankcase main bearing thickness					
1	mm (in)	2.494–2.500 (0.0982–0.0984)			
2	mm (in)	2.498–2.504 (0.0983–0.0986)			
3	mm (in)	2.502–2.508 (0.0985–0.0987)			
Lower crankcase main bearing thickness					
1	mm (in)	2.494–2.500 (0.0982–0.0984)			
2	mm (in)	2.498–2.504 (0.0983–0.0986)			
3	mm (in)	2.502–2.508 (0.0985–0.0987)			
Lower crankcase main bearing thickness (J3)					
1	mm (in)	2.492–2.500 (0.0981–0.0984)			
2	mm (in)	2.496–2.504 (0.0983–0.0986)			
3	mm (in)	2.500–2.508 (0.0984–0.0987)			
Thrust bearing thickness (J3)	mm (in)	1.907–1.957 (0.0751–0.0770)			
Thermostat					
Opening temperature					
at 0.05 mm (0.0020 in)	°C (°F)	58–62 (136–144)			
Fully open temperature	°C (°F)	70 (158)			
Valve open lower limit	mm (in)	4.3 (0.17)			

Fuel system

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Fuel system					
Fuel pressure					
at engine start switch to “ON”					
Within 5 seconds(*1)	kPa (kgf/cm^2, psi)	300 (3.0, 43.5)			
at engine idle speed(*1)	kPa (kgf/cm^2, psi)	260 (2.6, 37.7)			
Canister holding pressure	kPa (kgf/cm^2, psi)	19.6 (0.196, 2.8)			

(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Fuel filter assembly holding pressure					
Fuel inlet positive pressure	kPa (kgf/cm^2, psi)	200 (2.0, 29.0)			
Fuel outlet negative pressure	kPa (kgf/cm^2, psi)	80 (0.8, 11.6)			
Float height					
Water detection position	mm (in)	30 (1.18)			
Vapor separator float height	mm (in)	60.5 ± 3.0 (2.38 ± 0.12)			

PTT unit

Item	Unit	Model			
		200 R	200 L	225 R	225 L
PTT unit					
Hydraulic pressure					
Down	MPa (kgf/cm^2)	6.7–8.7 (67–87)			
Up	MPa (kgf/cm^2)	13.0–15.0 (130–150)			
Up-relief lock screw height(*1)	mm (in)	1.07–1.27 (0.042–0.050)			
Down-relief lock screw depth(*1)	mm (in)	1.95–2.45 (0.077–0.096)			

(*1) The figures are for reference only.

Lower unit

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Lower unit					
Holding pressure	kPa (kgf/cm^2, psi)	70 (0.7, 10)			
Gear backlash					
Pinion-to-forward gear	mm (in)	0.26–0.65 (0.0102–0.0256)	0.46–0.82 (0.0181–0.0323)	0.26–0.65 (0.0102–0.0256)	0.46–0.82 (0.0181–0.0323)
Pinion-to-reverse gear	mm (in)	0.32–0.65 (0.0126–0.0256)	0.45–0.90 (0.0177–0.0354)	0.32–0.65 (0.0126–0.0256)	0.45–0.90 (0.0177–0.0354)
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50			
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50			
Reverse gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50			

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Propeller shaft					
Propeller shaft free play	mm (in)	0.20–0.50 (0.0079–0.0197)	0.25–0.35 (0.0098–0.0138)	0.20–0.50 (0.0079–0.0197)	0.25–0.35 (0.0098–0.0138)
Propeller shaft shims	mm	1.80, 1.90, 2.00, 2.10, 2.20	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	1.80, 1.90, 2.00, 2.10, 2.20	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Runout limit	mm (in)	0.02 (0.0008)			
Drive shaft					
Runout limit	mm (in)	0.2 (0.008)			

Electrical

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Ignition and ignition control system					
Spark plug gap	mm (in)	1.0–1.1 (0.039–0.043)			
Crank position sensor output peak voltage (W/B – B)					
at cranking (unloaded)	V	3.0			
at cranking (loaded)	V	2.7			
at 1,500 r/min (loaded)	V	14.5			
at 3,500 r/min (loaded)	V	17.8			
Crank position sensor resistance(*1) (W/R – B)	Ω	396–594			
Crank position sensor air gap	mm (in)	1.4–1.6 (0.055–0.063)			
Knock sensor resistance	kΩ	504–616			
Intake air temperature sensor resistance					
at 20 °C (68 °F)	kΩ	2.21–2.69			
Engine temperature sensor resistance (B/Y – B/Y)					
at 20 °C (68 °F)	kΩ	54.2–69.0			
at 100 °C (212 °F)	kΩ	3.12–3.48			
Thermoswitch ON temperature	°C (°F)	84–90 (183–194)			
Thermoswitch OFF temperature	°C (°F)	68–82 (154–180)			
Shift cut switch resistance					
at free position (L/Y – B)	kΩ	4.465–4.935			

(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Oil pressure sensor					
Output voltage(*1) (P/W – B)	V	3.4 at engine idle speed			
Electronic throttle valve control system					
TPS output voltage					
at 20 °C (68 °F)					
with remote control lever fully closed(*1)					
Sensor 1	V	0.750			
with remote control lever fully open					
Sensor 2	V	4.550			
Throttle valve opening angle(*1)					
with remote control lever fully closed	Degree	0.5–7.0			
with remote control lever fully opened	Degree	Above 39.8		Above 53.8	
Electronic throttle valve motor resistance(*1)					
at 20–30 °C (68–86 °F)	Ω	1.23–1.67			
Accelerator position sensor output voltage (P – B)					
with remote control lever fully closed					
Sensor 1	V	0.550–0.850			
Sensor 2	V	0.400–1.000			
with remote control lever fully open(*1)					
Sensor 1 and 2	V	Above 3.250			
Accelerator position sensor resistance(*1)					
at 20 °C (68 °F)					
with accelerator lever fully closed	kΩ	0.800			
with accelerator lever fully open	kΩ	5.300			

(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
Variable camshaft timing control system					
Oil control valve resistance at 20 °C (68 °F)	Ω	6.7–7.7			
Fuel control system					
Fuel injector resistance(*1) at 21 °C (70 °F)	Ω	12.0			
Low-pressure fuel pump resistance(*1)	Ω	1.3–4.0			
High-pressure fuel pump resistance(*1)	Ω	0.5–10			
Vapor shut-off valve resistance at 20 °C (68 °F)	Ω	30.0–34.0			
Starter motor					
Type		Sliding gear			
Output	kW	1.40			
Cranking time limit	Second	30			
Brushes					
Standard length	mm (in)	15.5 (0.61)			
Wear limit	mm (in)	9.5 (0.37)			
Commutator					
Standard diameter	mm (in)	29.0 (1.14)			
Wear limit	mm (in)	28.0 (1.10)			
Standard undercut	mm (in)	0.8 (0.03)			
Wear limit	mm (in)	0.2 (0.01)			
Charging system					
Fuse	A	80			
Stator coil output peak voltage (G – G)					
at cranking (unloaded)	V	8.3			
at 1,500 r/min (unloaded)	V	44.7			
at 3,500 r/min (unloaded)	V	97.7			
Stator coil resistance(*1) (G – G)					
at 20 °C (68 °F)	Ω	0.1144–0.1716			
Rectifier Regulator output peak voltage (R – Ground)					
at 1,500 r/min (unloaded)	V	13.0			
at 3,500 r/min (unloaded)	V	13.0			

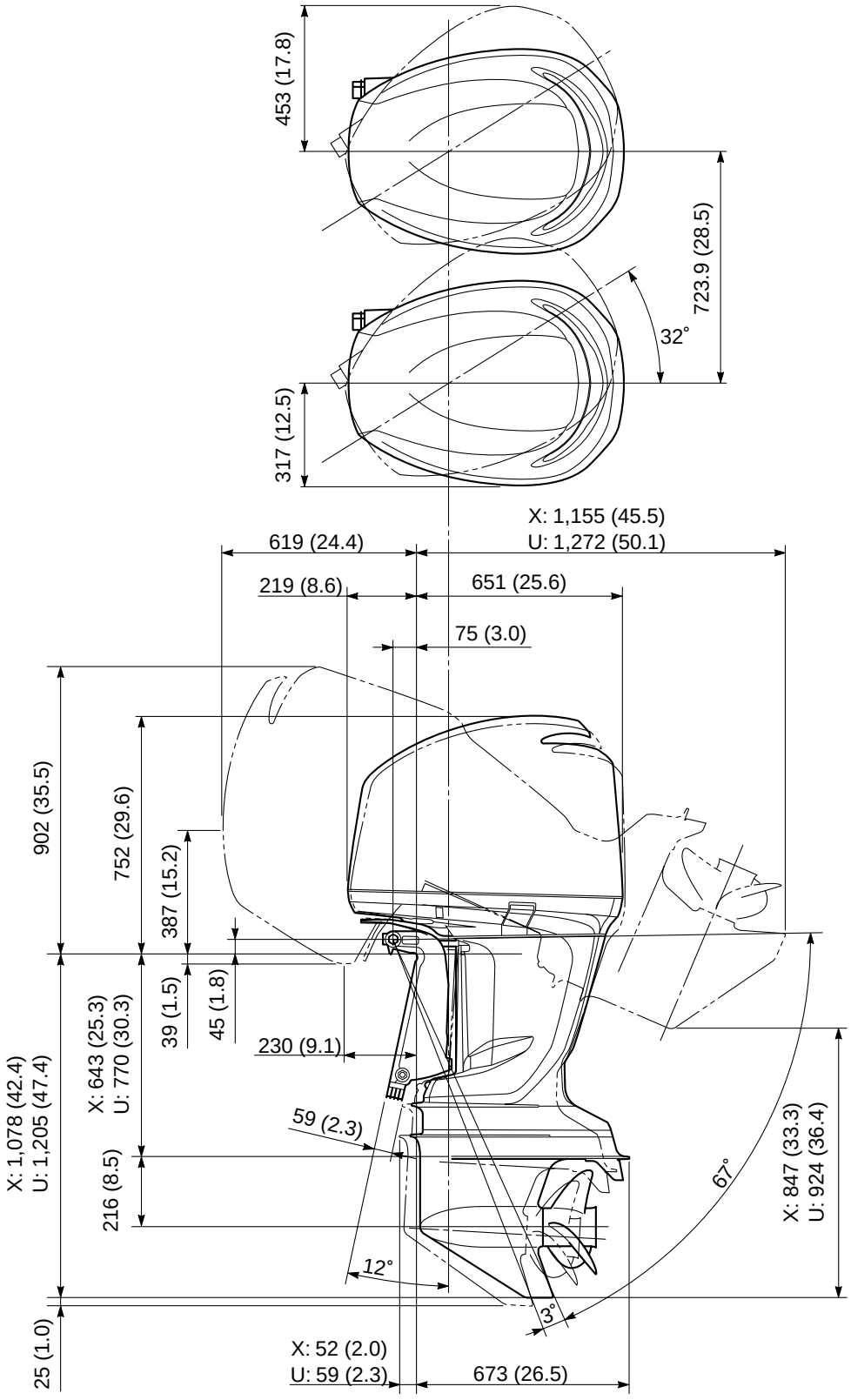
(*1) The figures are for reference only.

Item	Unit	Model			
		200 R	200 L	225 R	225 L
PTT system					
Trim sensor					
Setting resistance	Ω	10 ± 1			
Resistance	Ω	9–387.6			
Fluid type		ATF Dexron II			
PTT motor					
Output	kW	0.53			
Brushes					
Standard length	mm (in)	11.5 (0.45)			
Wear limit	mm (in)	4.5 (0.18)			
Commutator					
Standard diameter	mm (in)	23.0 (0.91)			
Wear limit	mm (in)	22.0 (0.87)			
Standard undercut	mm (in)	1.40 (0.055)			
Wear limit	mm (in)	0.90 (0.035)			

Dimension

Exterior Grey Whale 200 - Fin Whale 225

mm (in)

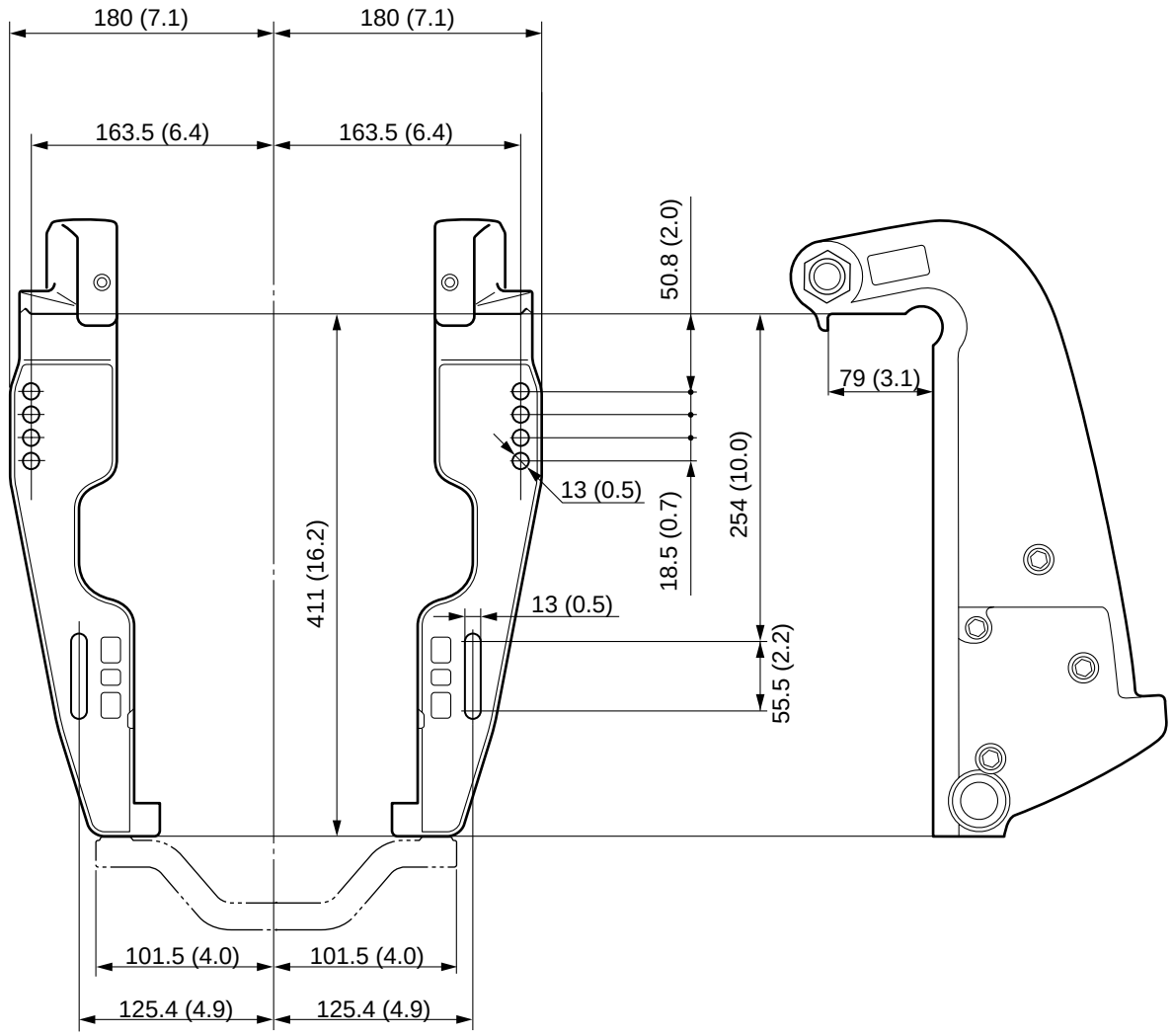


S6P22020

U (U-transom model): F225B regular rotation model only.

Clamp bracket Grey Whale 200 - Fin Whale 225

mm (in)



S6P22010

Tightening torque

Specified torque

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Intake manifold bolt		M6	10	1.0	7.4
Intake silencer bolt		M6	7	0.7	5.2
Electronic throttle valve assembly nut		—	13	1.3	9.6
Throttle damper plate bolt		M8	13	1.3	9.6
Canister mounting bolt		M6	5	0.5	3.7
Canister bracket bolt		M6	5	0.5	3.7
Vapor shut-off valve mounting nut		—	5	0.5	3.7
Intake air pressure sensor bolt		M6	5	0.5	3.7
Fuel filter assembly bolt		M6	6	0.6	4.4
Filter cup		—	5	0.5	3.7
Low-pressure fuel pump cover bolt		M6	9	0.9	6.6
Check valve holder screw		M5	4	0.4	3.0
Fuel cooler bolt		M6	5	0.5	3.7
Pressure regulator screw		M6	5	0.5	3.7
Float chamber cover screw		M4	2	0.2	1.5
Float chamber cover inner plate screw		M4	2	0.2	1.5
Float pin screw		M4	2	0.2	1.5
Vapor separator drain screw		—	2	0.2	1.5
Power unit					
Ignition coil bolt		M6	7	0.7	5.2
Spark plug		—	25	2.5	18.4
Cooling water pressure sensor adapter plug		M14	23	2.3	17.0
Cam position sensor bolt		M6	11	1.1	8.1
Flywheel magnet nut		—	240	24.0	177.0
Crank position sensor screw		M5	4	0.4	3.0
Timing belt tensioner bolt		—	39	3.9	28.8
Timing belt pulley bolt		M10	39	3.9	28.8
Variable camshaft timing cap		—	32	3.2	23.6
Variable camshaft timing bolt		M12	60	6.0	44.3
Driven sprocket bolt		M10	60	6.0	44.3
Cylinder head cover plate screw		M4	2	0.2	1.5
Camshaft cap bolt	1st	M7	8	0.8	5.9
	2nd		17	1.7	12.5
Cylinder head cover bolt	1st	M6	8	0.8	5.9
	2nd		8	0.8	5.9
Power unit mounting bolt		M10	42	4.2	31.0
Apron bolt		M6	8	0.8	5.9
Upper case cover bolt		M6	8	0.8	5.9
PTT motor lead bolt		M6	4	0.4	3.0
Positive battery cable bolt		M8	18	1.8	13.3

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Negative battery cable nut		—	13	1.3	9.6
Negative terminal bolt		—	26	2.6	19.2
PTT relay lead nut		—	4	0.4	3.0
Rectifier Regulator bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Anode screw		M4	3	0.3	2.2
ECM bolt		M6	7	0.7	5.2
Engine hanger bolt		M6	12	1.2	8.9
Cylinder head bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M10	23	2.3	17.0
	2nd		45	4.5	33.2
	3rd		Loosen completely		
	4th		23	2.3	17.0
	5th		45	4.5	33.2
	6th		90°		
Knock sensor		—	32	3.2	23.6
Cooling water passage cover bolt		M6	12	1.2	8.9
Anode bolt		M6	7	0.7	5.2
Exhaust cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Exhaust cover plug	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
		M18	55	5.5	40.6
Oil filter		—	18	1.8	13.3
Oil pressure sensor		—	18	1.8	13.3
Oil filter joint		—	34	3.4	25.1
Crankcase cover bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
Connecting rod cap bolt	1st	M9	23	2.3	17.0
	2nd		43	4.3	31.7
	3rd		90°		
Engine temperature sensor		—	15	1.5	11.1
Crankcase bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M8	25	2.5	18.4
	2nd		90°		
	1st	M10	40	4.0	29.5
	2nd		90°		
Oil pump cover screw		M6	4	0.4	3.0
Thermostat cover plug		M14	23	2.3	17.0
Anode bolt		M5	7	0.7	5.2
Lower unit (regular rotation model)					
Gear oil check screw		—	9	0.9	6.6

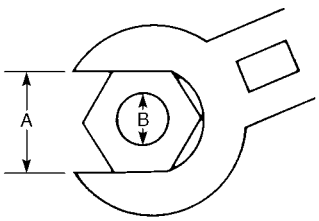
Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Gear oil drain screw	—	9	0.9	6.6
Lower case mounting bolt (nut)	M10	47	4.7	34.7
Trim tab bolt	M10	42	4.2	31.0
Propeller nut	—	54	5.4	39.8
Grease nipple	—	6	0.6	4.4
Propeller shaft housing bolt	M8	30	3.0	22.1
Cooling water inlet cover screw	M5	3	0.3	2.2
Pinion nut	—	142	14.2	104.7
Lower unit (counter rotation model)				
Gear oil check screw	—	9	0.9	6.6
Gear oil drain screw	—	9	0.9	6.6
Lower case mounting bolt	M10	47	4.7	34.7
Trim tab bolt	M10	42	4.2	31.0
Propeller nut	—	54	5.4	39.8
Ring nut	—	108	10.8	79.7
Grease nipple	—	6	0.6	4.4
Propeller shaft housing bolt	M8	30	3.0	22.1
Cooling water inlet cover screw	M5	3	0.3	2.2
Pinion nut	—	142	14.2	104.7
Bracket unit				
Shift cut switch screw	M4	2	0.2	1.5
Shift bracket bolt	—	19	1.9	14.0
Neutral switch screw	M4	2	0.2	1.5
Shift rod detent bolt	—	18	1.8	13.3
Grease nipple	—	1	0.1	0.7
Hose joint adapter screw	M6	5	0.5	3.7
Upper mount bracket bolt	M10	54	5.4	39.8
Apron stay	—	8	0.8	5.9
Engine oil drain bolt	M14	27	2.7	19.9
Upper mounting nut	—	72	7.2	53.1
Lower mounting nut	—	72	7.2	53.1
Oil pan assembly bolt	M8	20	2.0	14.8
	M10	42	4.2	31.0
PCV	—	8	0.8	5.9
Baffle plate screw	M6	4	0.4	3.0
Oil strainer bolt	M6	10	1.0	7.4
Oil pan bolt	M8	20	2.0	14.8
Exhaust manifold bolt	M8	20	2.0	14.8
Muffler bolt	M8	20	2.0	14.8
Friction plate screw	M6	4	0.4	3.0
Grease nipple	—	3	0.3	2.2
Self- locking nut	—	22	2.2	16.2
Thrust receiver nut	—	36	3.6	26.6

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
PTT unit				
Reservoir mounting bolt	M8	19	1.9	14.0
PTT motor mounting bolt	M8	19	1.9	14.0
Reservoir cap	M12	7	0.7	5.2
Manual valve	—	2	0.2	1.5
Pipe joint	—	15	1.5	11.1
Pipe joint adapter	—	20	2.0	14.8
Gear pump bolt	M5	7	0.7	5.2
Gear pump bracket bolt	M5	7	0.7	5.2
Trim cylinder end screw	—	160	16.0	118.0
Tilt ram	—	55	5.5	40.6
Tilt cylinder end screw	—	90	9.0	66.4
Tilt piston bolt	M6	7	0.7	5.2

General torque

This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified torque is reached. Unless otherwise specified, torque specifications require clean, dry threads. Components should be at room temperature.

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.7
10 mm	M6	8	0.8	5.9
12 mm	M8	18	1.8	13.3
14 mm	M10	36	3.6	26.6
17 mm	M12	43	4.3	31.7



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Periodic check and adjustment

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3

Maintenance interval chart

Use the following chart as a guideline for general maintenance.
Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every		Refer to page
		10 hours (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Anodes (external)	Check/replace		○	○		3-16
Anodes (cylinder head, thermostat cover)	Check/replace				○	3-16
Battery	Check/charge	○				3-17
Cooling water passages	Clean		○	○		3-10
Top cowling	Check				○	3-3
Fuel filter	Check/ replace(*1)	○	○	○		3-4
Fuel filter (low-pressure fuel pump)	Check/replace	○	○	○		4-22
Fuel system	Check	○	○	○		3-3
Gear oil	Change	○		○		3-14
Lubrication points	Lubricate			○		3-18
Engine idle speed	Check				○	3-11
PCV	Check				○	7-12
PTT unit	Check				○	3-13
Propeller and cotter pin	Check/replace		○	○		3-16
Shift link/shift cable	Check/adjust				○	3-12
Thermostat	Check/replace				○	3-9
Throttle link/throttle cable/ throttle pick-up timing	Check/adjust				○	3-11
Water pump	Check/replace				○	6-5, 6-34
Engine oil	Check/change	○		○		3-5
Oil filter (cartridge)	Change				○	3-7
Spark plugs	Clean/adjust/ replace	○			○	3-8
Timing belt	Check/replace			○	○	3-8

(*1) Check the water detection switch each time the fuel filter is checked. To check the water detection switch, see Chapter 8, “Checking the water detection switch.”

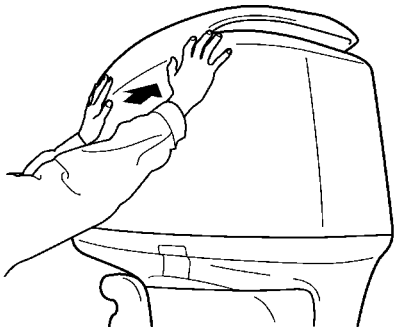
NOTE:
When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.

Item	Remarks	Every		Refer to page
		500 hours (2.5 years)	1,000 hours (5 years)	
Timing belt	Replace		○	5-15
Valve clearance (DOHC)	Check/adjust	○		5-9
Fuel filter (vapor separator tank)	Replace		○	4-27
Oil control valve filter	Replace		○	5-43
Anodes (exhaust cover, cooling water passage cover, Rectifier Regulator cover)	Replace		○	3-16
Exhaust guide, exhaust manifold	Check/replace		○	7-13

Top cowling

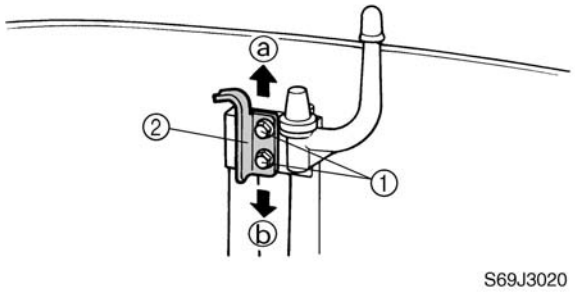
Checking the top cowling

1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.


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2. Loosen the bolts ①.

3. Move the hook ② up or down slightly to adjust its position.



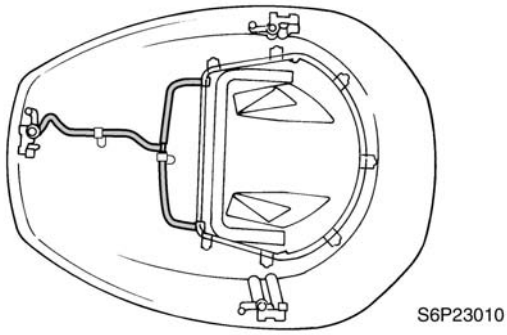
S69J3020

NOTE:
- To loosen the fitting, move the hook ② in direction ⓐ.
- To tighten the fitting, move the hook ② in direction ⓑ.

4. Tighten the bolts ①.

5. Check the fitting again and, if necessary, repeat steps 2–4.

6. Check the top cowling hoses. Replace if cracked or damaged.


S6P23010

Fuel system

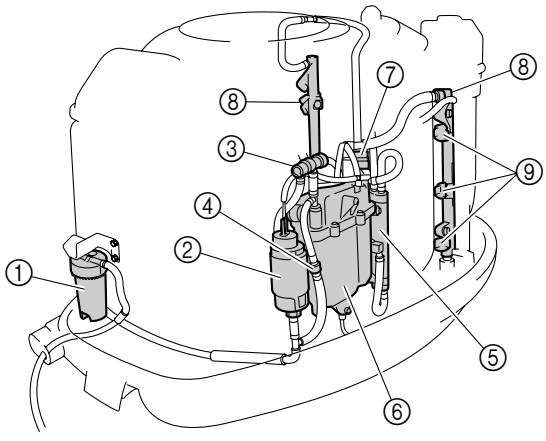
Checking the fuel joint and fuel hose (fuel joint-to-fuel injector)

1. Remove the flywheel magnet cover, port intake manifold, and fuel rail covers (port and starboard).

NOTE:
See the exploded diagram (4-9, 4-23).

2. Check the low-pressure fuel hose connections. Also, check the fuel filter ①, low-pressure fuel pump ②, filter ③, check valve ④, and fuel cooler ⑤. Replace the low-pressure fuel hose connections if there is leakage or deterioration.

3. Check the high-pressure fuel hose connections. Also, check the vapor separator ⑥, pressure regulator ⑦, fuel rails ⑧, and fuel injectors ⑨. Replace the high-pressure fuel hose connections if there is leakage or deterioration.



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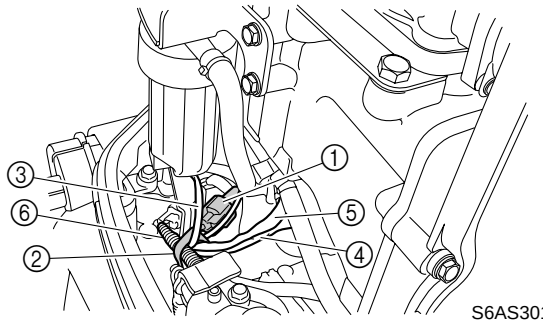
4. Install the port intake manifold, fuel rail covers, and flywheel magnet cover.

NOTE:
To install the intake manifold, see Chapter 4, "Installing the intake manifold."

Checking the fuel filter

1. Disconnect the water detection switch coupler (blue) ①.

2. Remove the clamp ② from the water detection switch lead ③, isolator lead ④, oil pressure sensor lead ⑤, and PTT switch lead ⑥.



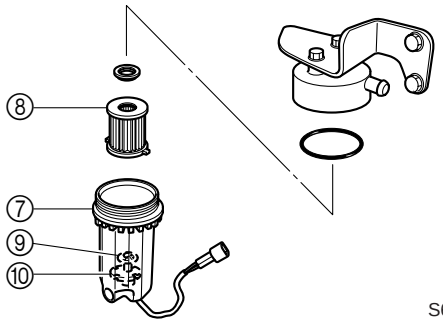
S6AS3010

3. Remove the fuel filter cup assembly ⑦.

NOTE:
- Do not twist the water detection switch lead ③ when removing the fuel filter cup assembly ⑦.
- Be sure not to spill any fuel when removing the fuel filter cup assembly.

4. Check the fuel filter element ⑧. Replace the fuel filter element if there is dirt or residue.

5. Check the fuel filter cup assembly ⑦. Clean with straight gasoline if there are foreign substance or replace if cracked.



S6AS3021

NOTE:
- When cleaning the fuel filter cup assembly, be sure not to remove the clip ⑨ and float ⑩, otherwise the water detection switch may be damaged.
- To check the fuel cup for leaks, see Chapter 4, "Checking the fuel filter assembly."
- Check the water detection switch each time the fuel filter is checked.
- To check the water detection switch, see Chapter 8, "Checking the water detection switch."

6. Install the fuel filter cup assembly ⑦.

NOTE:
Do not twist the water detection switch lead ③ when installing the fuel filter cup assembly ⑦.

7. Connect the water detection switch coupler (blue) ①.

8. Fasten the water detection switch lead ③, isolator lead ④, oil pressure sensor lead ⑤, and PTT switch lead ⑥ with the clamp ②.

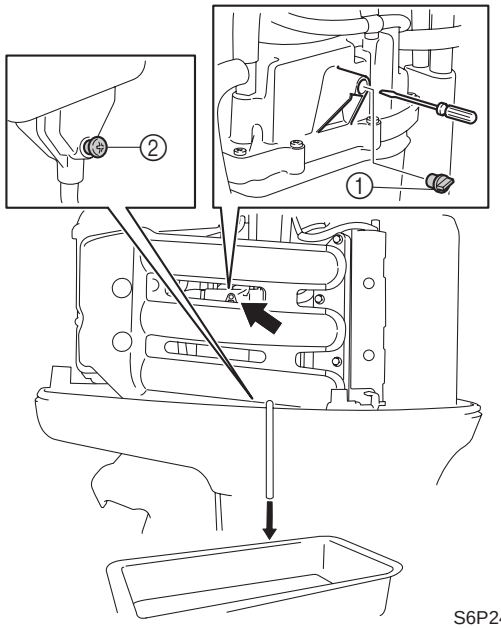
NOTE:
Be sure to leave a little slack in the water detection switch lead.

Draining the fuel

1. Reduce the fuel pressure.

NOTE:
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Remove the cap ①.
3. Cover the pressure check valve of the vapor separator with a rag, and then press in the pressure check valve using a thin screwdriver to release the fuel pressure.
4. Place a drain pan under the vapor separator drain hose, and then loosen the vapor separator drain screw ②.
5. Drain the fuel from the vapor separator drain hose by pressing the pressure check valve using a thin screwdriver.



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⚠ WARNING
Reduce the fuel pressure before loosening the vapor separator drain screw, or pressurized fuel will spray out and may result in serious injury.

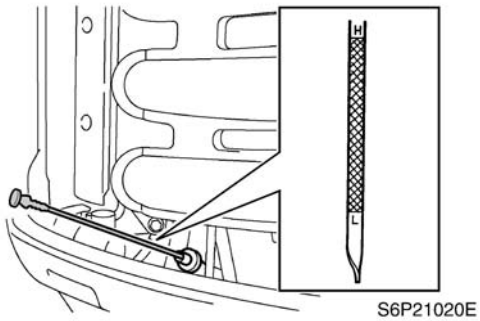
6. Tighten the vapor separator drain screw ②.

Vapor separator drain screw ②:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

Power unit

Checking the engine oil

1. Place the outboard motor in an upright position.
2. Remove the oil dipstick, wipe it clean, and then insert it back into the dipstick guide.
3. Remove the oil dipstick again to check the oil level, and to check the oil for discoloration and its viscosity.

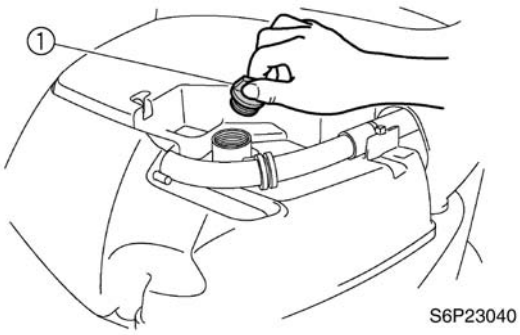


S6P21020E

NOTE:
- Change the oil if it appears milky or dirty.
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

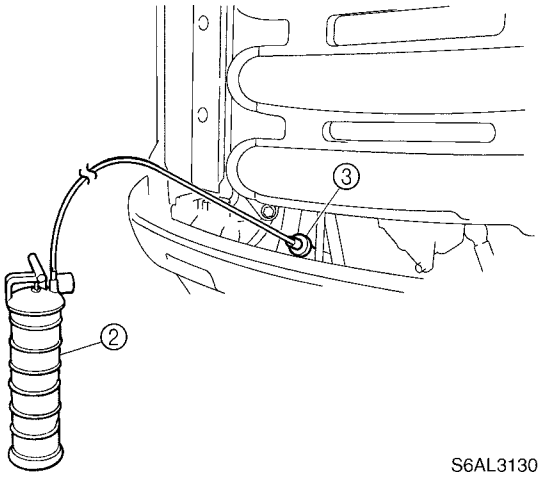
Changing the engine oil (extracting)

1. Start the engine, warm it up, and then turn it off.
2. Remove the oil dipstick and oil filler cap ①.



S6P23040

3. Insert the tube of the oil changer ② into the dipstick guide ③.



4. Operate the oil changer to extract the oil.

NOTE:
Be sure to clean up any oil spills.

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, or 10W-40
Engine oil quantity:
Without oil filter replacement:
5.6 L (5.92 US qt, 4.93 Imp qt)

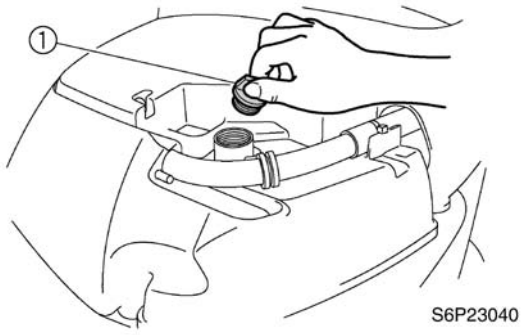
6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and that there is no oil leakage. If the oil level is low, add engine oil to the correct level.

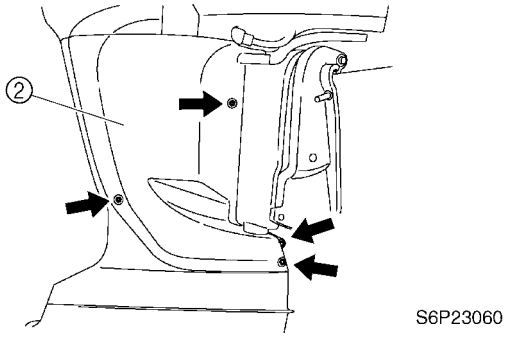
Changing the engine oil (draining)

1. Start the engine, warm it up, and then turn it off.

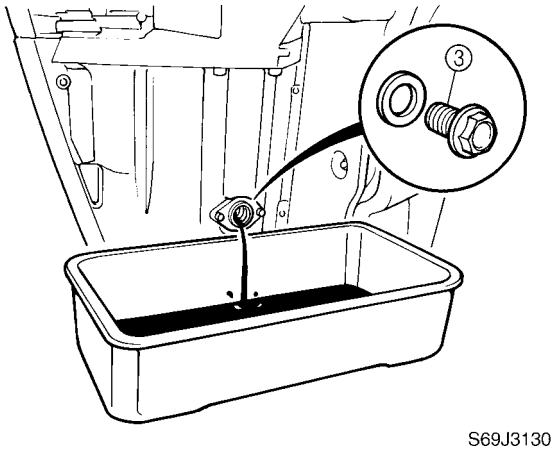
2. Remove the oil dipstick and oil filler cap ①.



3. Remove the starboard apron ②.



4. Place a drain pan under the drain hole, and then remove the engine oil drain bolt ③ and let the oil drain completely.



NOTE:
Be sure to clean up any oil spills.

5. Install the engine oil drain bolt ③, and then tighten it to the specified torque.

Engine oil drain bolt ③:
27 N·m (2.7 kgf·m, 19.9 ft·lb)

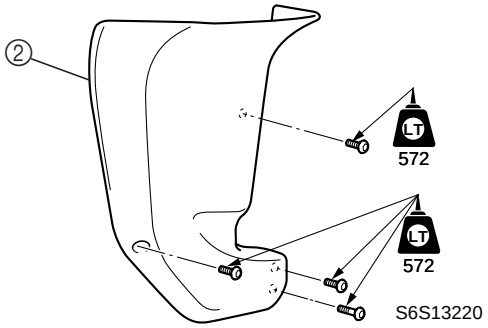
6. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, or 10W-40
Engine oil quantity:
Without oil filter replacement:
5.6 L (5.92 US qt, 4.93 Imp qt)

7. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

8. Turn the engine off, and then check the oil level and that there is no oil leakage. If the oil level is low, add engine oil to the correct level.

9. Install the starboard apron ②, and then tighten the apron bolts to the specified torque.



Apron bolt:
8 N·m (0.8 kgf·m, 5.9 ft·lb)

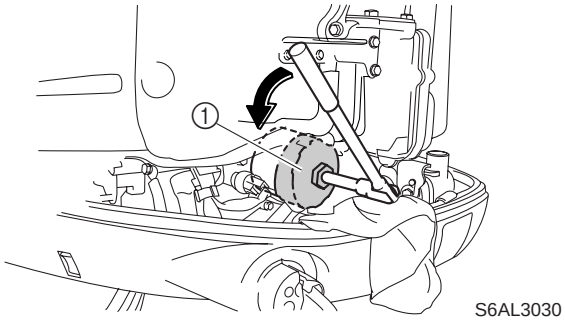
Replacing the oil filter

CAUTION:

Do not damage the oil pressure sensor and its lead when replacing the oil filter.

1. Extract the engine oil with an oil changer or drain it.

2. Place a rag under the oil filter, and then remove the oil filter using a 72.5 mm (2.9 in) oil filter wrench ①.

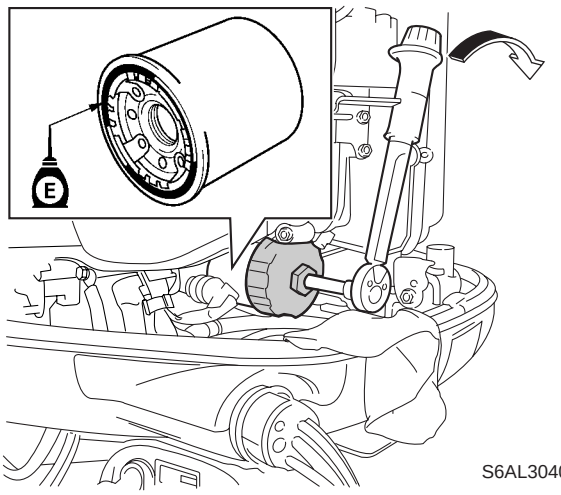


NOTE:
- Wait more than 5 minutes after turning the engine off to replace the oil filter.
- Be sure to clean up any oil spills.

Oil filter wrench ①: 90890-06830

3. Apply a thin coat of engine oil to the O-ring of the new oil filter.

4. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, or 10W-40
Engine oil quantity:
With oil filter replacement:
5.8 L (6.13 US qt, 5.10 Imp qt)

6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and that there is no oil leakage. If the oil level is low, add engine oil to the correct level.

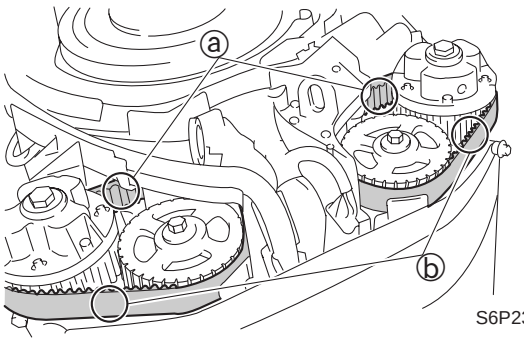
Checking the timing belt

CAUTION:

Do not turn the flywheel magnet counter-clockwise, otherwise the water pump impeller may be damaged.

1. Remove the flywheel magnet cover.

2. While turning the flywheel magnet clockwise, check the interior ⓐ and the exterior ⓑ of the timing belt. Replace the timing belt if cracked, damaged, or worn.



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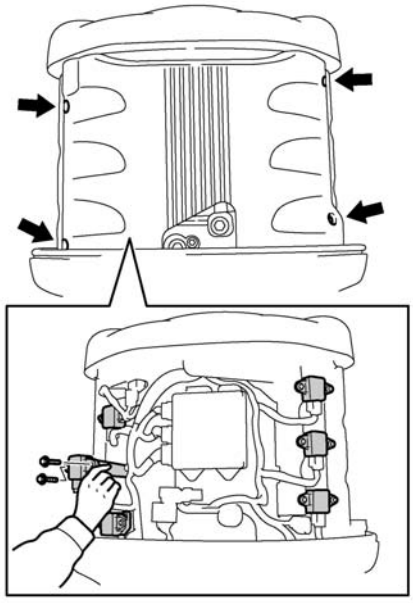
NOTE:

To replace the timing belt, see Chapter 5, “Replacing the timing belt.”

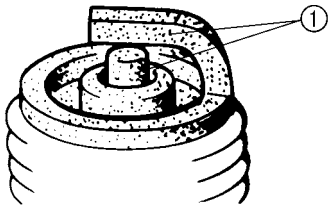
Checking the spark plug

1. Remove the ECM cover.

2. Remove the ignition coils, and then remove the spark plugs.


S6P23110

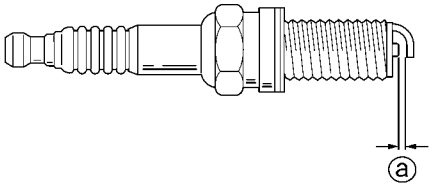
3. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



S69J3190

4. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.

5. Check the spark plug gap ⓐ. Adjust the spark plug gap if out of specification.



S69J3200

Specified spark plug:
LFR6A-11 (NGK)
Spark plug gap ⓐ:
1.0–1.1 mm (0.039–0.043 in)

6. Install the spark plugs, tighten them temporarily, then to the specified torque using a spark plug wrench.

Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

7. Install the ignition coils.

Ignition coil bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

8. Install the ECM cover.

Checking the thermostat

1. Reduce the fuel pressure.

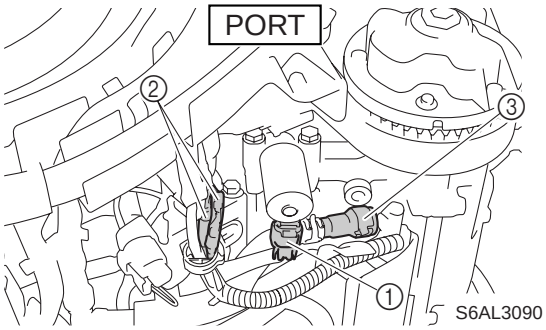
NOTE:
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Remove the flywheel magnet cover.

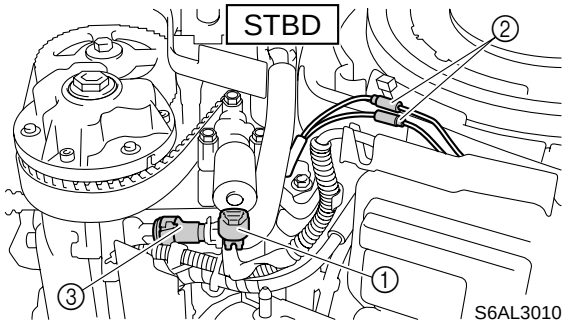
3. Disconnect the oil control valve couplers ①.

4. Disconnect the thermoswitch connectors ②.

5. Disconnect the quick connectors ③.



S6AL3090



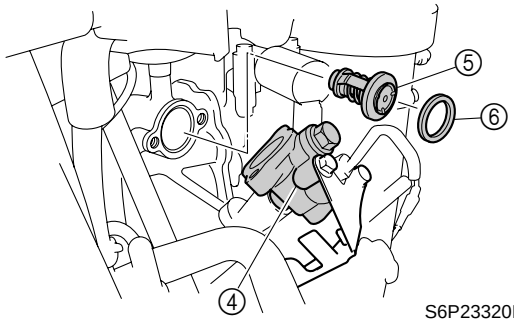
S6AL3010

⚠ WARNING

It is dangerous if the quick connectors are disconnected suddenly since pressurized fuel will spray out. Be sure to reduce the fuel pressure before disconnecting the quick connectors.

NOTE:
To disconnect the quick connector, see Chapter 4, "Disconnecting the quick connector."

6. Remove the thermostat covers ④ and thermostats ⑤ (port and starboard).

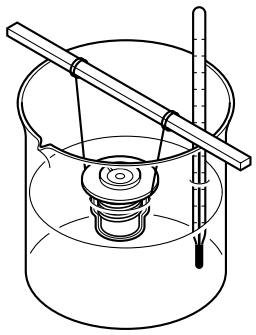


S6P23320E

CAUTION:

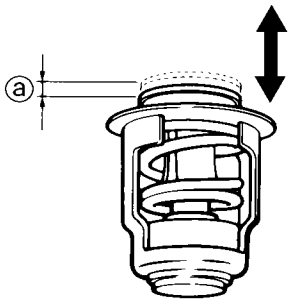
Do not reuse the gaskets ⑥, always replace them with new ones.

7. Suspend the thermostat in a container of water.
8. Place a thermometer in the water and slowly heat the water.



S69J5E40

9. Measure the thermostat valve opening ⓐ at the specified water temperatures. Replace the thermostat if out of specification.



S6AL3100

Water temperature	Valve opening
58–62 °C (136–144 °F)	0.05 mm (0.0020 in) (valve begins to open)
above 70 °C (158 °F)	more than 4.3 mm (0.17 in)

10. Install the thermostats and thermostat covers (port and starboard).

NOTE:

It is recommended to check the thermostat cover anodes before installing the thermostat covers.

11. Connect the thermoswitch connectors, quick connectors, and oil control valve couplers.
12. Route and fasten the wiring harness in its original position.

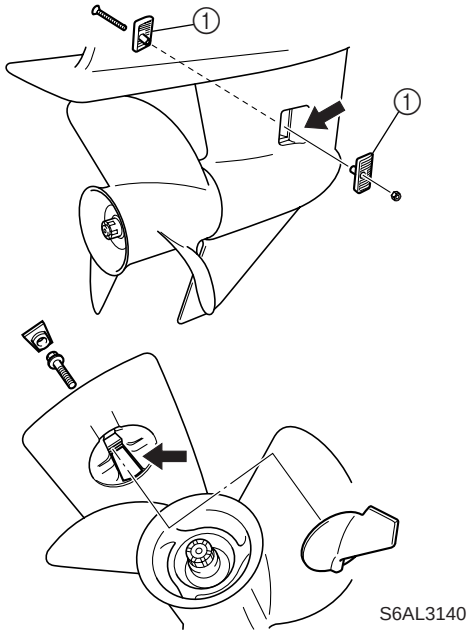
NOTE:

To route and fasten the wiring harness, see Chapter 8, “Wiring harness routing.”

13. Install the flywheel magnet cover.

Checking the cooling water passage

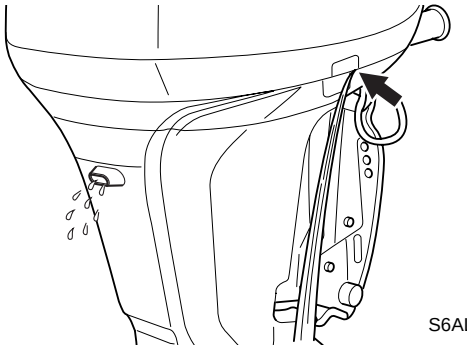
1. Check the cooling water inlet covers ① and cooling water inlet. Clean if clogged.



S6AL3140

2. Place the lower unit in water, and then start the engine.

3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.


S6AL3180

Control system

Checking the engine idle speed

1. Start the engine and warm it up for 5 minutes.

2. Check the engine idle speed using the Selva genuine tachometer (on-board meter) or using the YDIS.

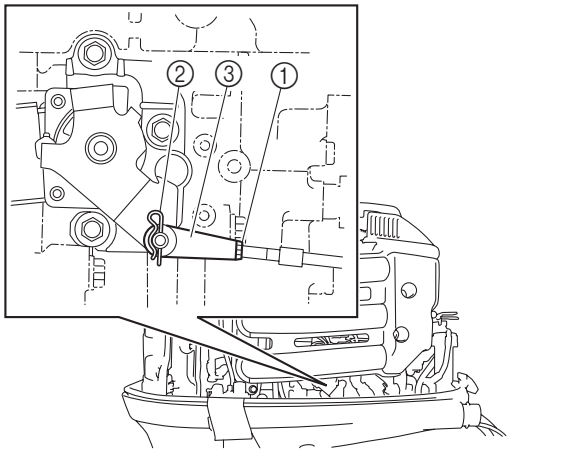
NOTE:
To connect and operate the YDIS, see Chapter 9, "YDIS" and the YDIS (Ver. 1.23a or later) Instruction Manual.

Engine idle speed: 600–700 r/min

Adjusting the throttle cable

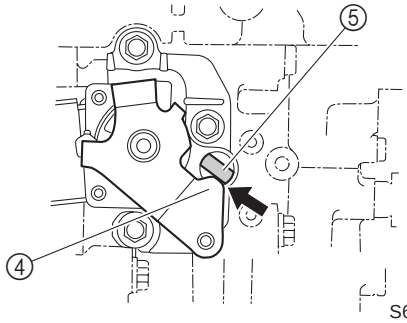
1. Set the remote control lever to the neutral position and fully close the throttle lever.

2. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.



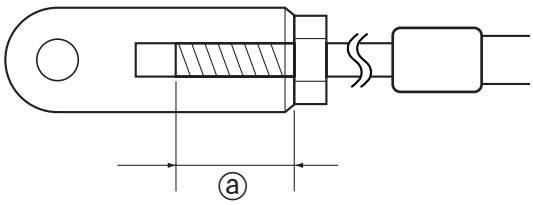
S6P23330

3. Check that the accelerator lever ④ contacts the fully closed stopper ⑤.



S6AL3190

4. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on the accelerator lever ④.

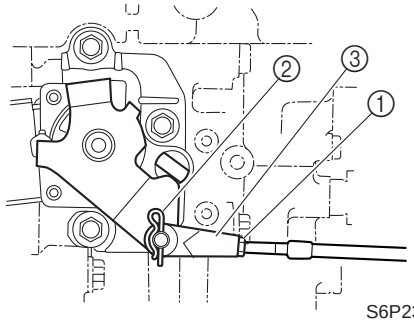


S6AL3110

⚠ WARNING
The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓐ.

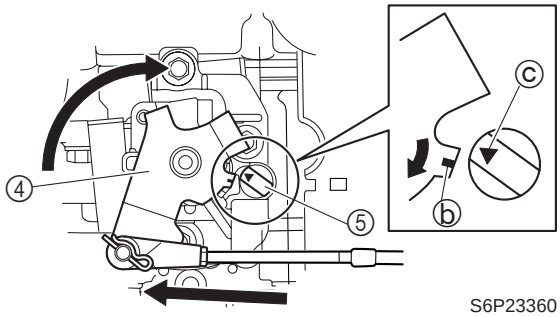
NOTE:
Pull the throttle cable towards the engine to remove any free play in the cable before adjusting the position of the throttle cable joint.

5. Connect the throttle cable joint ③, install the clip ②, and then tighten the locknut ①.



S6P23350

6. Operate the remote control lever several times, and then check that the mark ⓑ on the accelerator lever ④ has passed the mark ⓒ on the fully closed stopper ⑤ when the remote control lever is in the fully open position of the throttle.



S6P23360

7. Check that the accelerator lever ④ contacts the fully closed stopper ⑤ when the remote control lever is in the fully closed position.

8. Check the throttle cable for smooth operation and, if necessary, repeat steps 2–7.

Checking the gear shift operation

1. Check that the gear shift operates smoothly when shifting it from the neutral position to forward or reverse. Adjust the shift cable length if necessary.

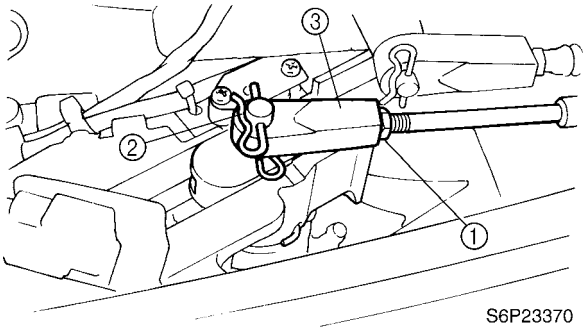
2. Check the neutral switch for continuity. Adjust the shift cable length or check the neutral switch if necessary.

NOTE:
To check the neutral switch, see Chapter 8, "Checking the neutral switch."

Gear shift position	Lead color	
	Blue/green (L/G)	Black (B)
Forward or reverse		
Neutral	○	○

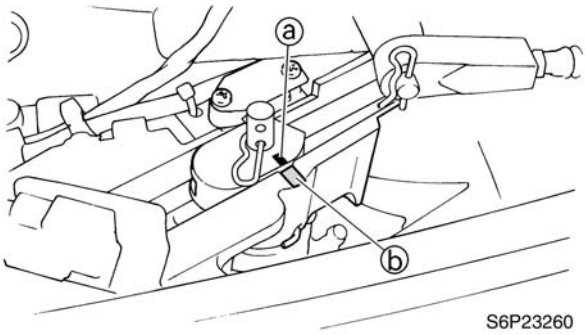
3. Set the gear shift to the neutral position.

4. Loosen the locknut ①, remove the clip ②, and then disconnect the shift cable joint ③.



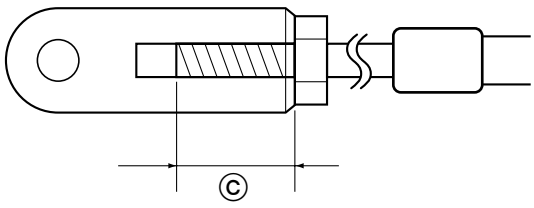
S6P23370

5. Align the alignment mark ⓐ on the bushing and alignment mark ⓑ on the bracket.



S6P23260

6. Adjust the position of the shift cable joint until its hole is aligned with the set pin.



S6AL3120

⚠ WARNING

The shift cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

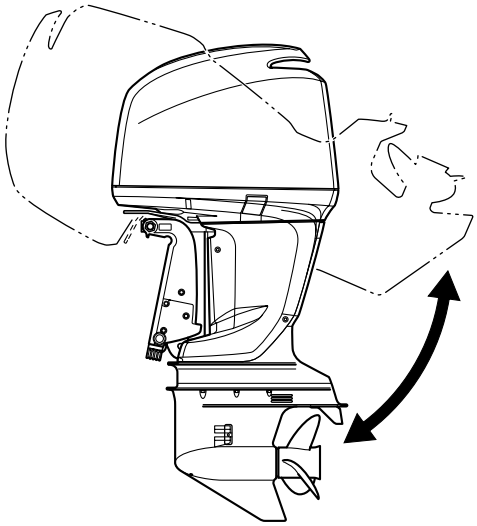
7. Connect the cable joint, install the clip, and then tighten the locknut.

8. Check the gear shift for smooth operation, check the operation of the neutral switch and, if necessary, repeat steps 3–7.

Bracket unit

Checking the PTT operation

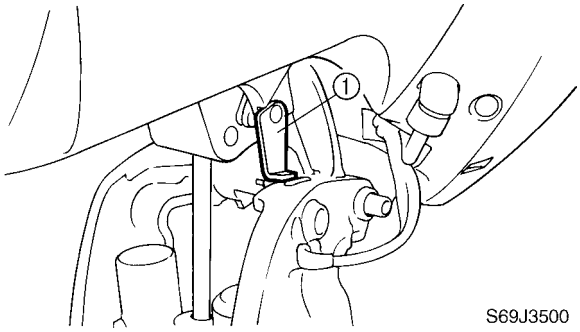
1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the PTT fluid level if necessary.


S6P23190

NOTE:

Be sure to listen to the winding sound of the PTT motor for smooth operation.

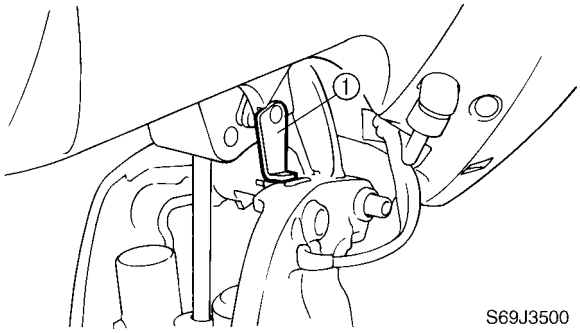
2. Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



S69J3500

Checking the PTT fluid level

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.

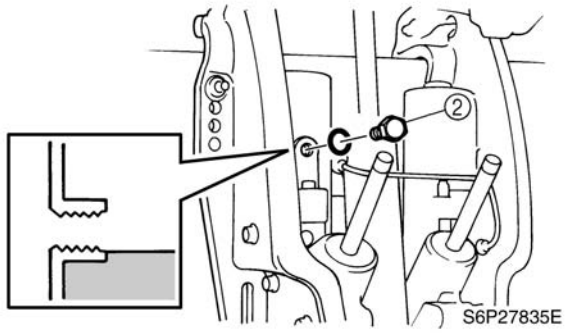


S69J3500

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.

2. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



⚠ WARNING

Make sure that the trim and tilt rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.

NOTE:

If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole when the reservoir cap is removed.

3. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended PTT fluid:
ATF Dexron II

4. Install a new O-ring and the reservoir cap ②, and then tighten the reservoir cap to the specified torque.

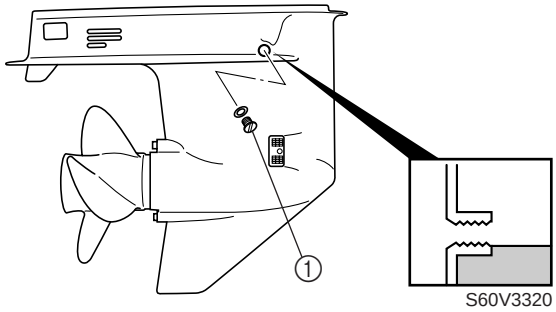
Reservoir cap ②:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Lower unit

Checking the gear oil level

1. Fully tilt the outboard motor down.

2. Remove the gear oil check screw ①, and then check the gear oil level in the lower case.



NOTE:

If the oil is at the correct level, a small amount of oil should overflow out of the check hole when the gear oil check screw is removed.

3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.

Recommended gear oil:
Hypoid gear oil
API: GL-4
SAE: 90

4. Install a new gasket and the gear oil check screw ①, and then tighten the gear oil check screw to the specified torque.

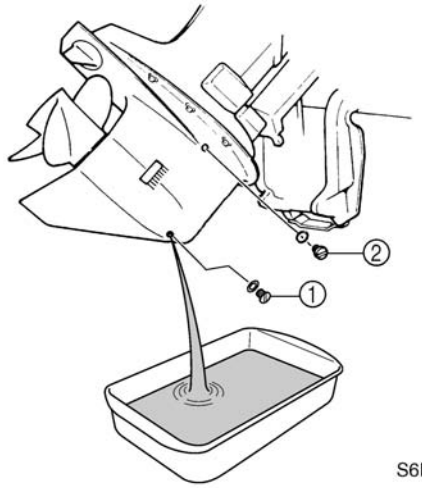
Gear oil check screw ①:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Changing the gear oil

1. Tilt the outboard motor up slightly.

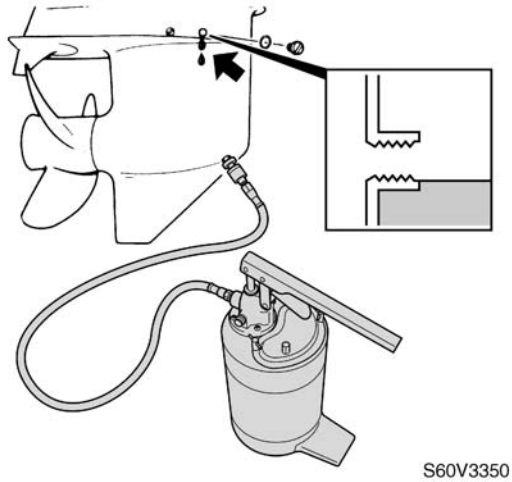
3

2. Place a drain pan under the gear oil drain hole, remove the gear oil drain screw ①, then the gear oil check screw ② and let the oil drain completely.



3. Check the oil for metal and discoloration, and check its viscosity. Check the internal parts of the lower case if necessary.

4. Insert a gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.



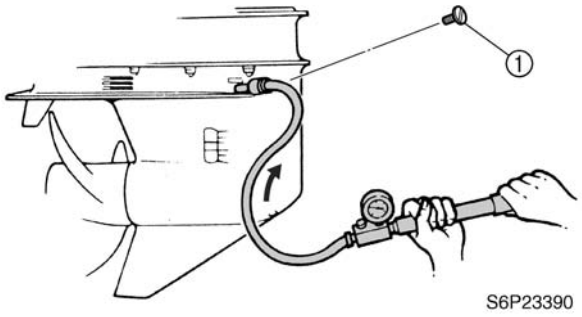
Recommended gear oil:
Hypoid gear oil
API: GL-4
SAE: 90
Gear oil quantity:
Regular rotation model:
1,150 cm^3
(38.9 US oz, 40.6 Imp oz)
Counter rotation model:
1,000 cm^3
(33.8 US oz, 35.3 Imp oz)

5. Install new gaskets and the gear oil check screw ②, and quickly install the gear oil drain screw ①, and then tighten them to the specified torque.

Gear oil check screw ② and drain screw ①:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Checking the lower unit for air leakage

1. Remove the gear oil check screw ①, and then install the special service tool.



Leakage tester: 90890-06840

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 10 seconds.

CAUTION:
Do not over pressurize the lower unit, otherwise the oil seals may be damaged.

NOTE:
Cover the check hole with a rag when removing the tester from the lower unit.

Lower unit holding pressure:
70 kPa (0.7 kgf/cm^2, 10 psi)

3. If the specified pressure cannot be maintained, check the drive shaft, propeller shaft and shift rod oil seals for damage. If necessary, check each shaft for bends and damage.

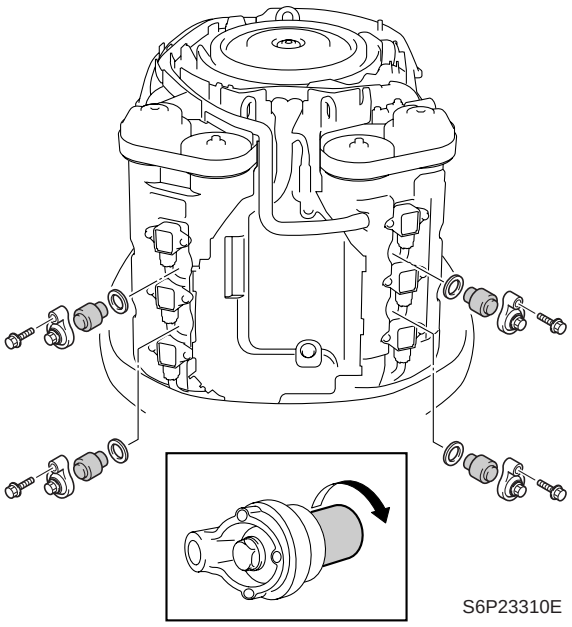
Checking the propeller

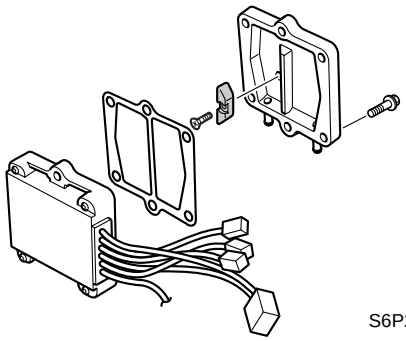
1. Check the propeller blades and splines. Replace the propeller if cracked, damaged, or worn.

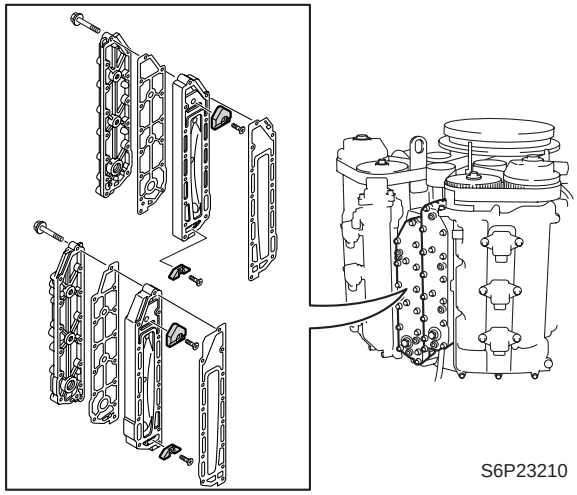
General

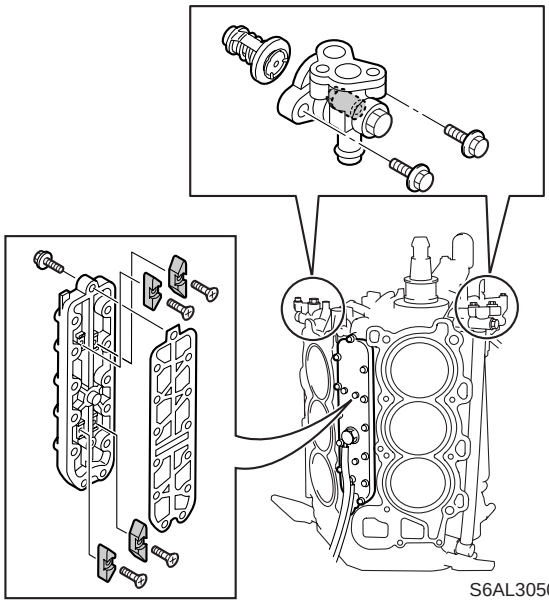
Checking the anode

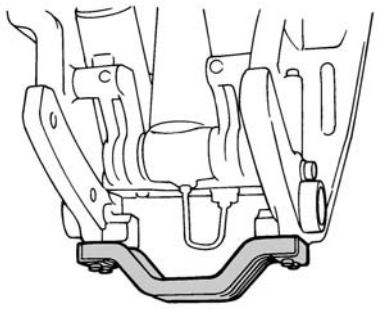
1. Check the anodes and trim tab. Clean the anodes or trim tab if there are scales, grease, or oil.

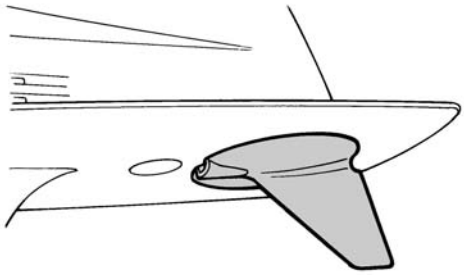

S6P23310E


S6P23270E


S6P23210


S6AL3050


S69J3600


S69J3610

CAUTION:

Do not oil, grease, or paint the anodes or the trim tab, otherwise they will be ineffective.

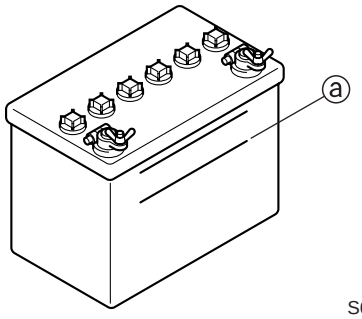
NOTE:

If it is necessary to disassemble the outboard motor to check an anode, refer to the applicable disassembly procedure in this manual.

2. Replace the anodes or trim tab if excessively eroded. In addition, check the ground lead.

Checking the battery

1. Check the battery electrolyte level. If the level is at or below the minimum level mark ⓐ, add distilled water until the level is between the maximum and minimum level marks.



S69J3620

2. Check the specific gravity of the electrolyte. Fully charge the battery if below specification.

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.

Always follow these preventive measures:

- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):

- **SKIN – Wash with water.**
- **EYES – Flush with water for 15 minutes and get immediate medical attention.**

Antidote (INTERNAL):

- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.**

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:

- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flames (e.g., welding equipment, lighted cigarettes).**
- **DO NOT SMOKE when charging or handling batteries.**

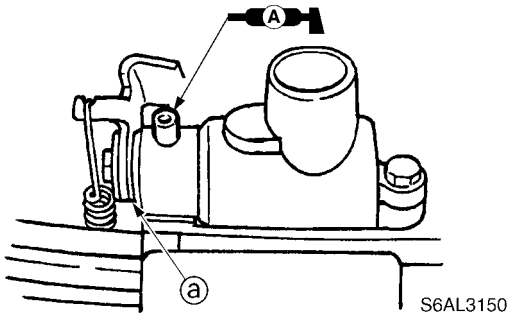
KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery cable first, then the positive battery cable.

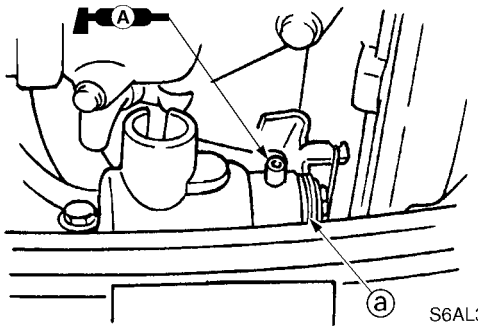
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

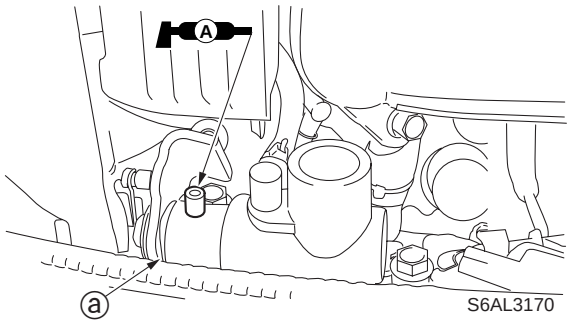
1. Apply water resistant grease to the areas shown.



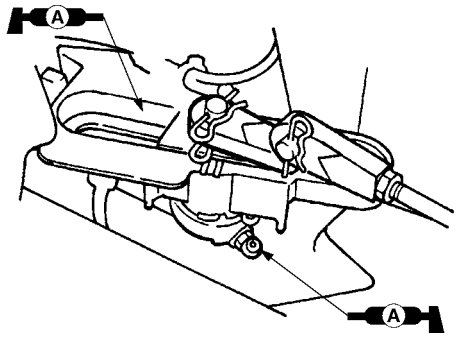
S6AL3150



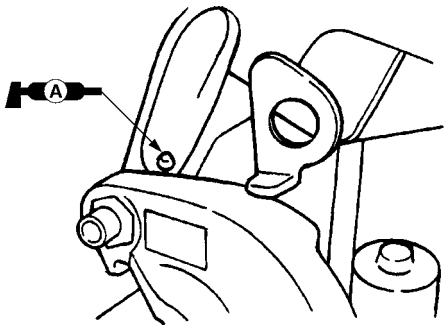
S6AL3160



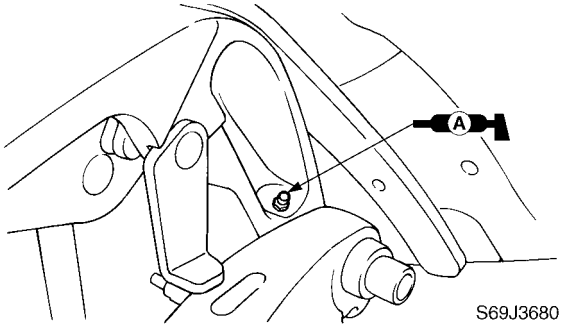
S6AL3170



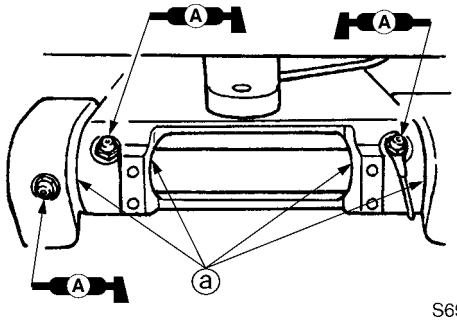
S69J3660



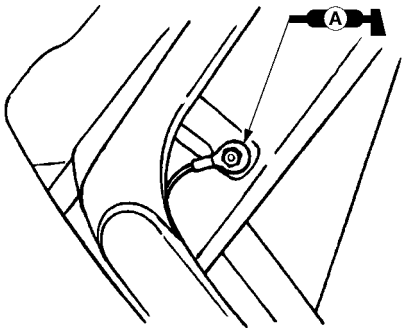
S69J3670



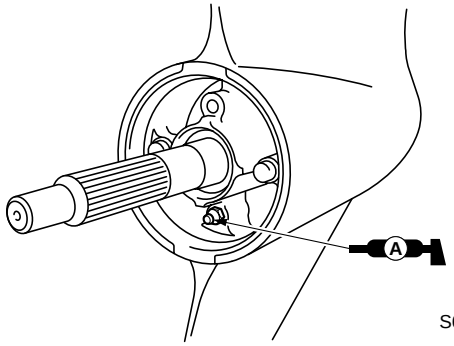
S69J3680



S69J3690

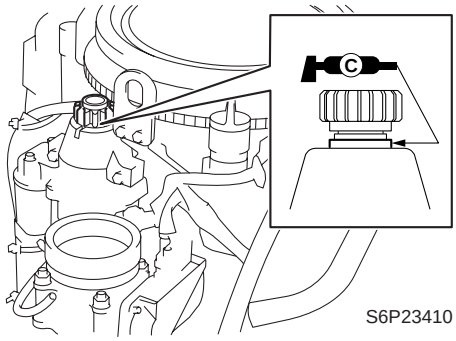


S69J3700

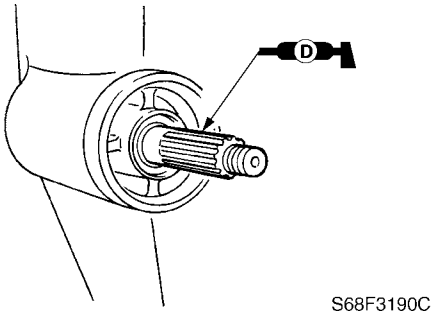


NOTE:
Apply grease to the grease nipple until it flows from the bushings ⓐ.

2. Apply low temperature resistant grease to the area shown.



3. Apply corrosion resistant grease to the area shown.



Fuel system

Hose routing 4-1
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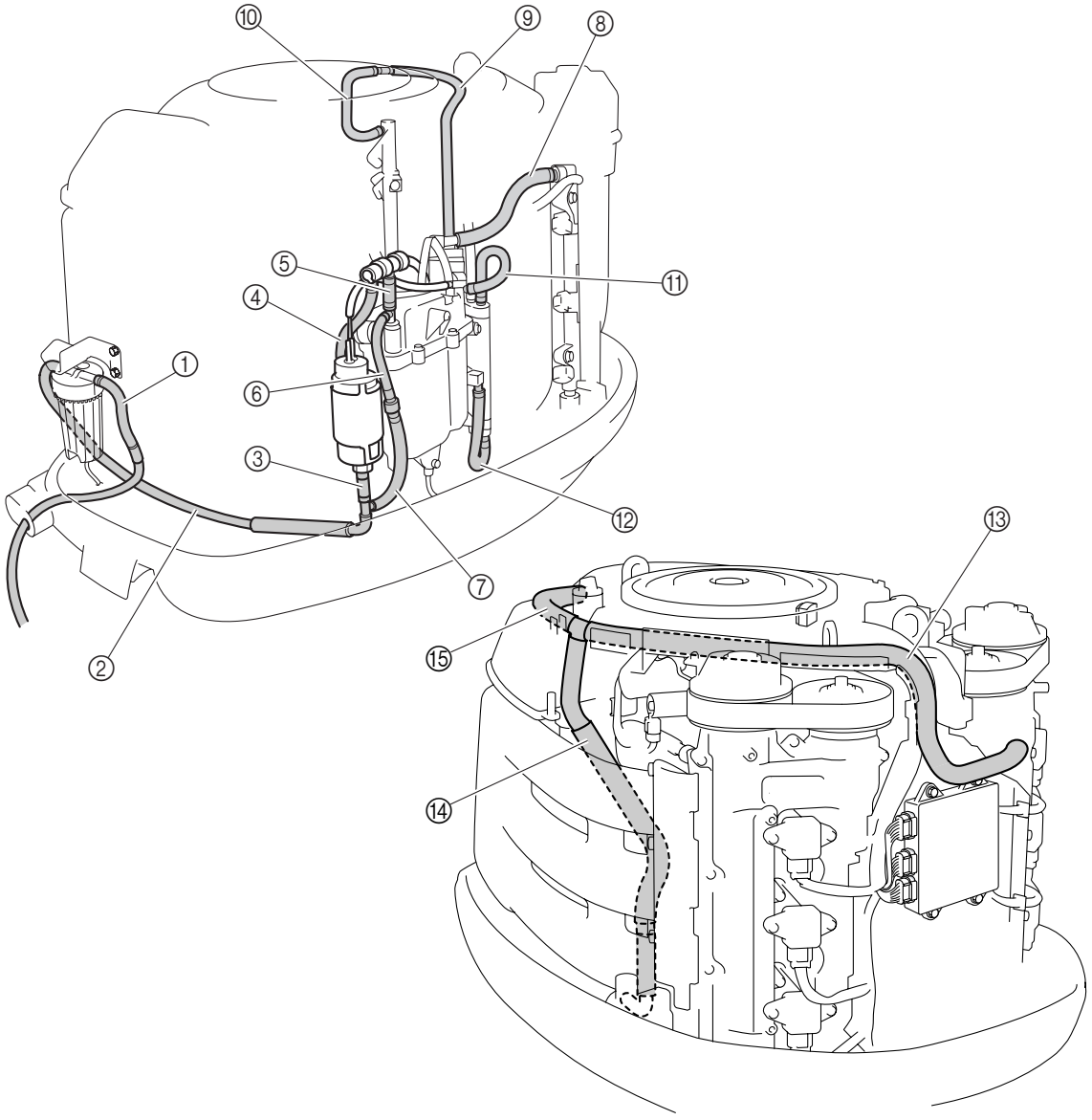
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Hose routing

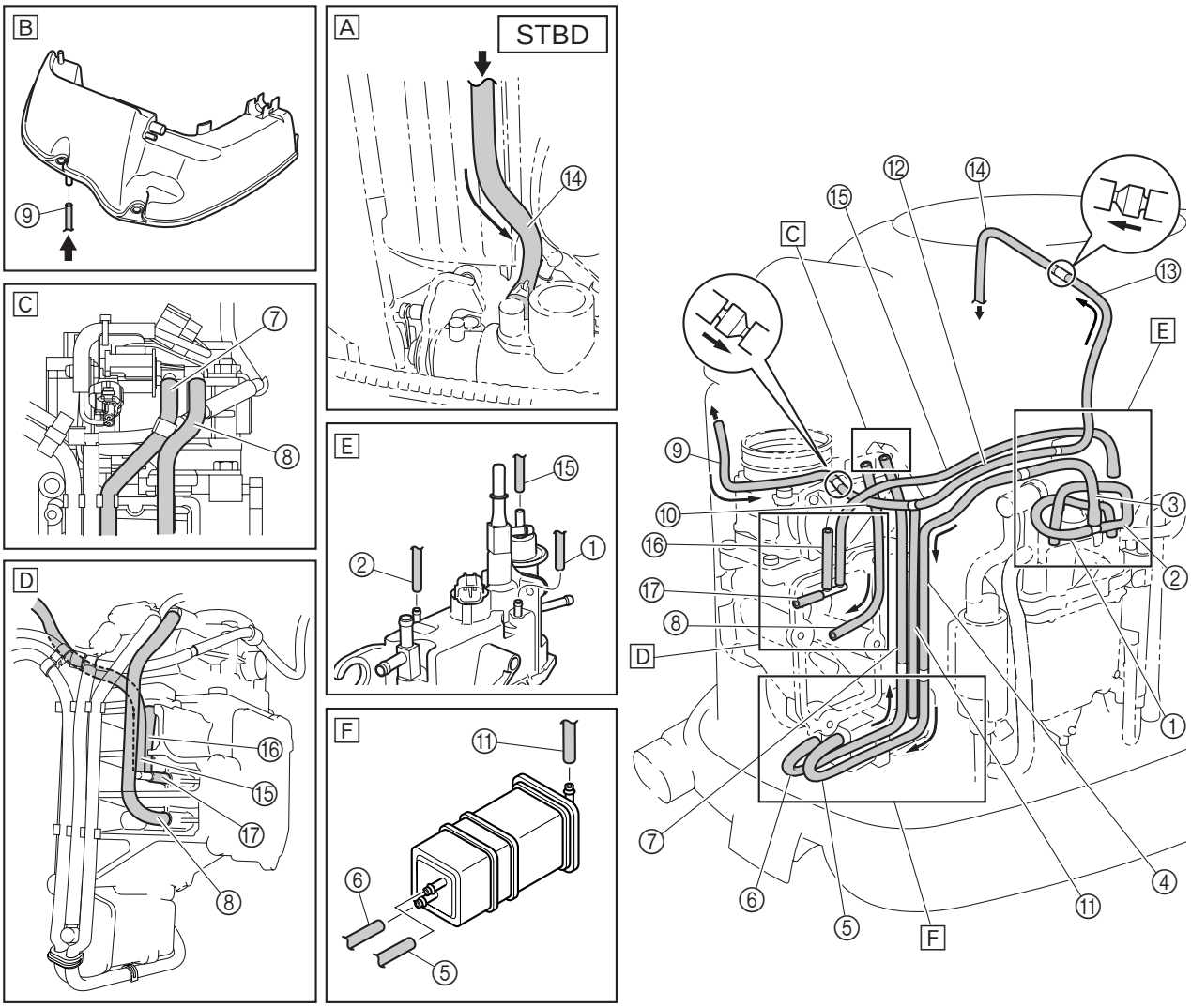
Fuel hose and blowby hose



S6AS4030

① Fuel hose (fuel joint-to-fuel filter)
② Fuel hose (fuel filter-to-joint)
③ Fuel hose (joint-to-low-pressure fuel pump)
④ Fuel hose (low-pressure fuel pump-to-filter)
⑤ Fuel hose (filter-to-joint)
⑥ Fuel hose (joint-to-check valve)
⑦ Fuel hose (check valve-to-joint)
⑧ Fuel hose (vapor separator-to-quick connector)
⑨ Fuel hose (quick connector-to-joint)
⑩ Fuel hose (joint-to-quick connector)
⑪ Fuel hose (pressure regulator-to-fuel cooler)
⑫ Fuel hose (fuel cooler-to-vapor separator)
⑬ Blowby hose (starboard cylinder head cover-to-joint)
⑭ Blowby hose (joint-to-cylinder block)
⑮ Blowby hose (joint-to-intake silencer)

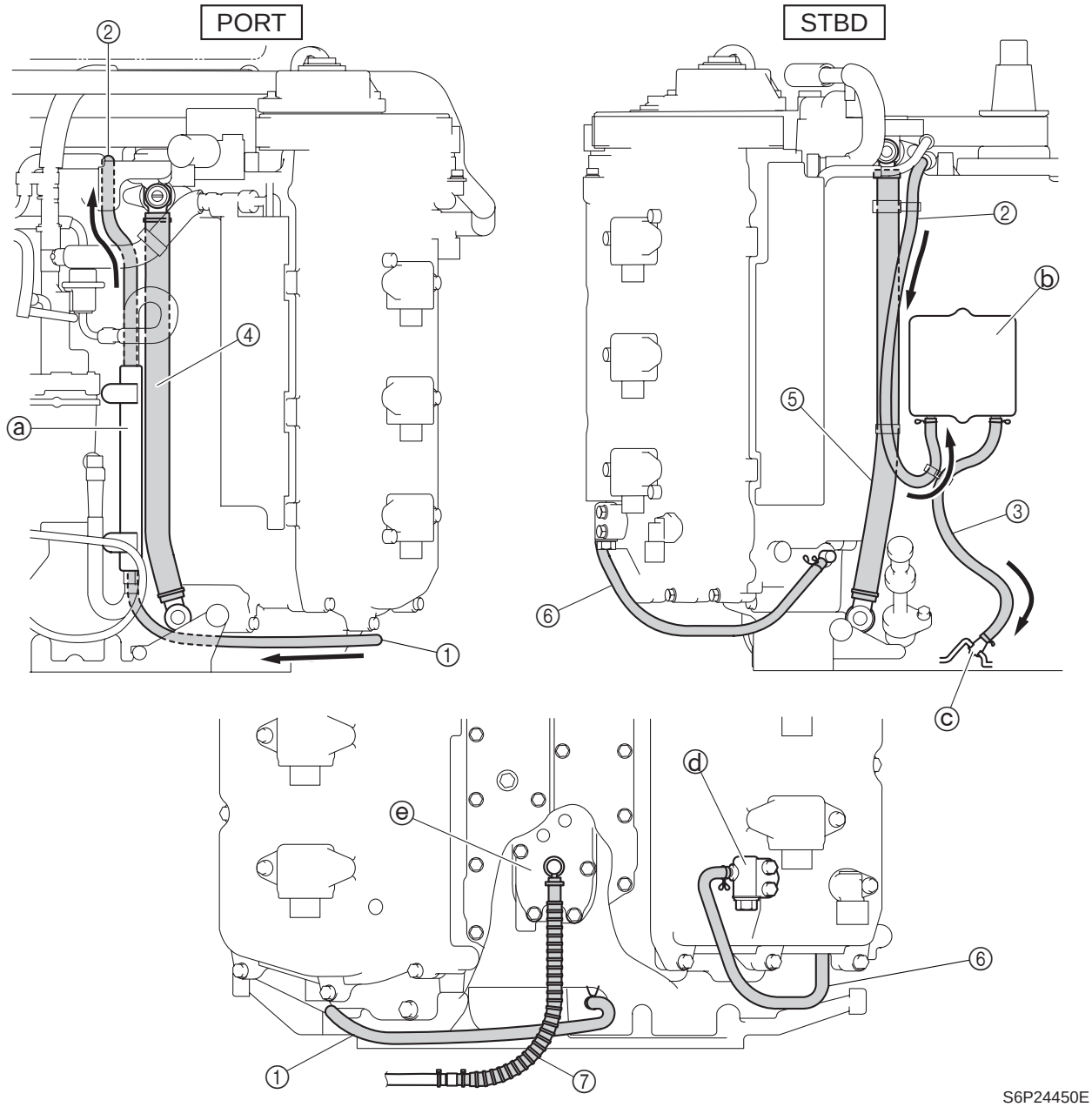
Vapor gas hose



S6AL4160

① Vapor gas hose (vapor separator-to-joint)
② Vapor gas hose (vapor separator-to-joint)
③ Vapor gas hose (joint-to-joint)
④ Vapor gas hose (joint-to-joint)
⑤ Vapor gas hose (joint-to-canister tank port)
⑥ Vapor gas hose (canister purge port-to-joint)
⑦ Vapor gas hose (joint-to-vapor shut-off valve)
⑧ Vapor gas hose (vapor shut-off valve-to-surge tank)
⑨ Vapor gas hose (intake silencer-to-check valve)
⑩ Vapor gas hose (check valve-to-joint)
⑪ Vapor gas hose (canister atmospheric port-to-joint)
⑫ Vapor gas hose (joint-to-joint)
⑬ Vapor gas hose (joint-to-check valve)
⑭ Vapor gas hose (check valve-to-top cowling lock)
⑮ Vacuum hose (pressure regulator-to-joint)
⑯ Vacuum hose (intake air pressure sensor-to-joint)
⑰ Vacuum hose (joint-to-surge tank)

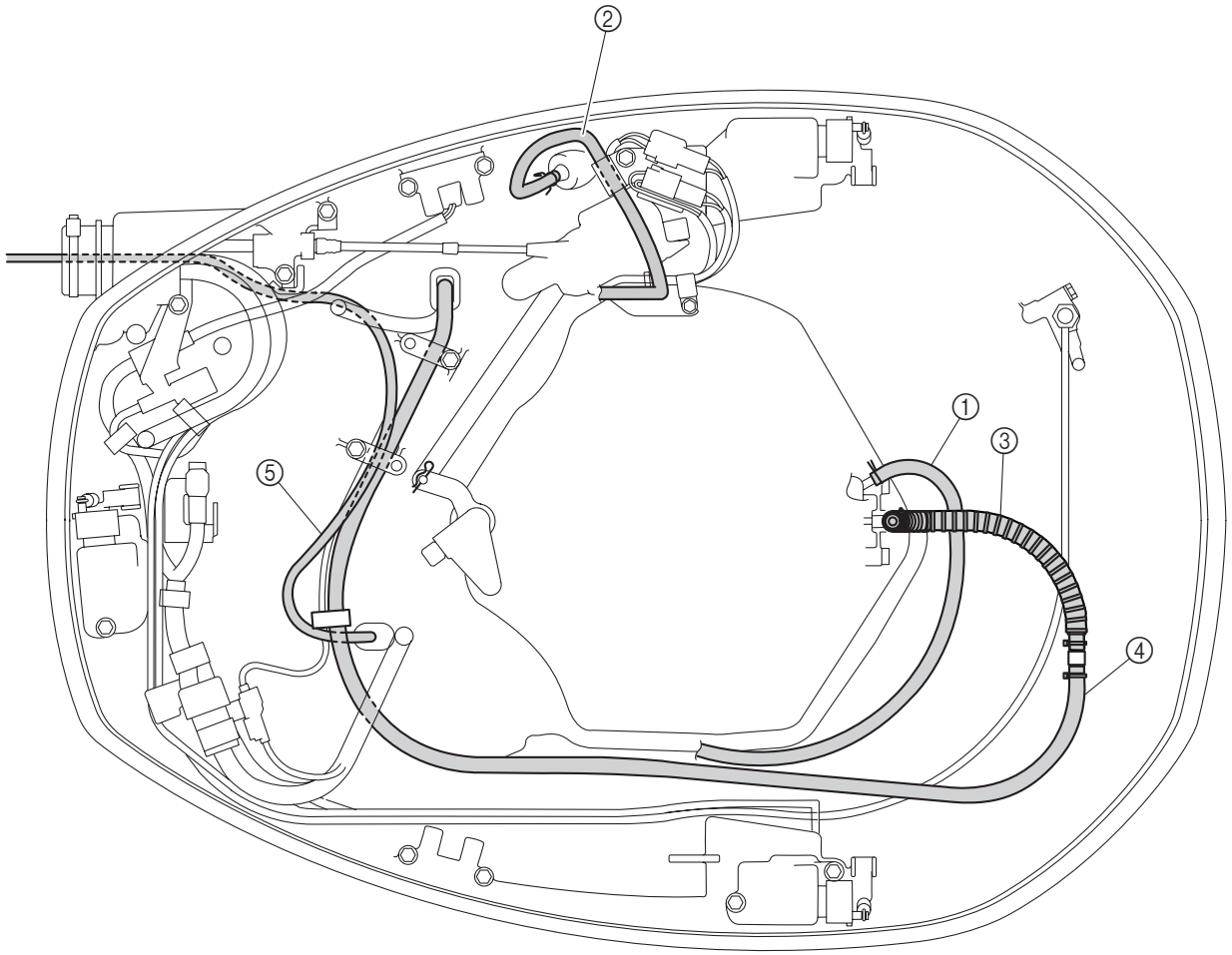
Cooling water hose



S6P24450E

① Cooling water hose (cylinder block-to-fuel cooler)
② Cooling water hose (fuel cooler-to-Rectifier Regulator)
③ Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
④ Cooling water hose (port thermostat cover-to-cylinder block)
⑤ Cooling water hose (starboard thermostat cover-to-cylinder block)
⑥ Cooling water hose (starboard cylinder head-to-cooling water pressure sensor adapter)
⑦ Flushing hose (joint-to-cooling water passage cover)

ⓐ Fuel cooler
ⓑ Rectifier Regulator
ⓒ Cooling water pilot hole (on the bottom cowling)
ⓓ Cooling water pressure sensor adapter
ⓔ Cooling water passage cover (on the cylinder block)



S6P24490

① Cooling water hose (cylinder block-to-fuel cooler)
② Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
③ Flushing hose (joint-to-cooling water passage cover)
④ Flushing hose (flushing hose adapter-to-joint)
⑤ Speedometer hose

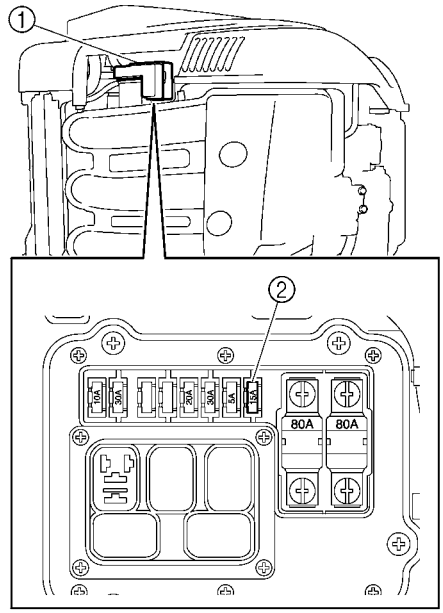
Fuel system

Reducing the fuel pressure

⚠ WARNING

Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

1. Remove the fuse holder cover ①, and then remove the high-pressure fuel pump fuse (15 A) ②.



S6P24260

2. Start the engine.

NOTE:

- If the engine starts, it will stall after a few seconds.
- If the engine does not start, crank the engine 2 or 3 times.

3. After the engine stalls, crank the engine 2 or 3 times.

4. Turn the engine start switch to "OFF."

Disconnecting the quick connector

⚠ WARNING

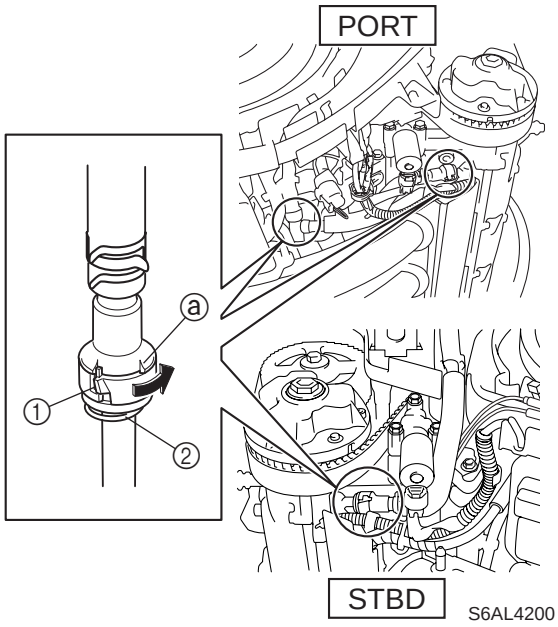
If the quick connector is disconnected suddenly, pressurized fuel could spray out. Be sure to reduce the fuel pressure before disconnecting the quick connector.

1. Reduce the fuel pressure.

NOTE:

To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Wrap the quick connector with a rag, and then rotate the quick connector tab ① to the stopper position ⓐ.

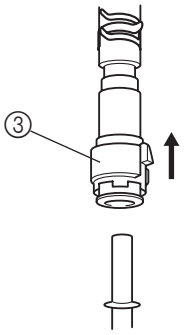


S6AL4200

CAUTION:

- **Do not rotate the quick connector tab ① past the stopper position ⓐ, otherwise it could be damaged.**
- **When the fuel hose is disconnected, quickly remove the retainer ② from the quick connector, otherwise the retainer could be lost.**

3. Disconnect the quick connector ③ from the fuel rail or vapor separator directly.



S6P24280

NOTE:
Cover the quick connector, fuel rail, and vapor separator with a plastic bag to prevent damage and to protect them from dirt.

Measuring the fuel pressure

1. Reduce the fuel pressure.

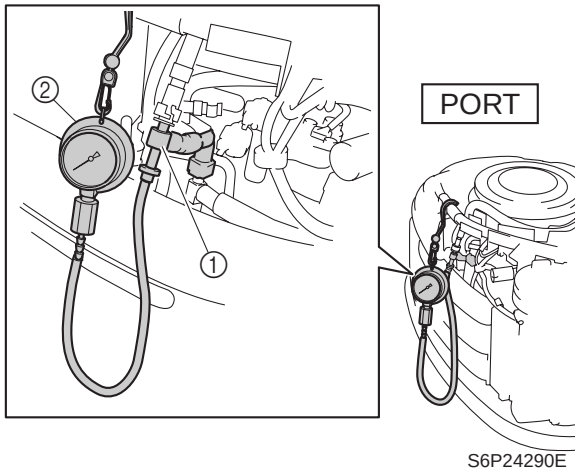
NOTE:
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Disconnect the quick connector from the vapor separator.

NOTE:
To disconnect the quick connector, see Chapter 4, "Disconnecting the quick connector."

3. Connect the fuel pressure gauge adapter B ① between the quick connector and vapor separator.

4. Connect the fuel pressure gauge ② to fuel pressure gauge adapter B ①.



S6P24290E

⚠ WARNING

- **Gently screw in the gauge until it is firmly connected to prevent fuel from leaking out.**
- **Before measuring the fuel pressure, make sure that the drain screw is tightened securely.**
- **Do not loosen the drain screw while measuring the fuel pressure. Loosening the drain screw can cause fuel to spray out creating a fire hazard.**

Fuel pressure gauge adapter B ①:
90890-06942
Fuel pressure gauge ②:
90890-06786

5. Turn the engine start switch to "ON," and then measure the fuel pressure within 5 seconds.

NOTE:
- The fuel pressure will decrease 5 seconds after the engine start switch is turned to "ON" because the high-pressure fuel pump will stop.
- The high-pressure fuel pump does not operate when the engine start switch is turned to "ON" again within 10 seconds after turning the switch to "OFF."

Fuel pressure (reference data):
300 kPa (3.0 kgf/cm^2, 43.5 psi)

6. Start the engine, warm it up for 5 minutes, and then measure the fuel pressure at engine idle speed. If below specification, check the high-pressure fuel line and the vapor separator.

Fuel pressure (reference data):
260 kPa (2.6 kgf/cm^2, 37.7 psi)
at engine idle speed

7. Reduce the fuel pressure.

NOTE:
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

8. Disconnect the special service tools.

⚠ WARNING
- **After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the drain screw to drain the remaining fuel from the hose and gauge.**
- **When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.**

9. Connect the quick connector.

Checking the pressure regulator

1. Reduce the fuel pressure.

NOTE:
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

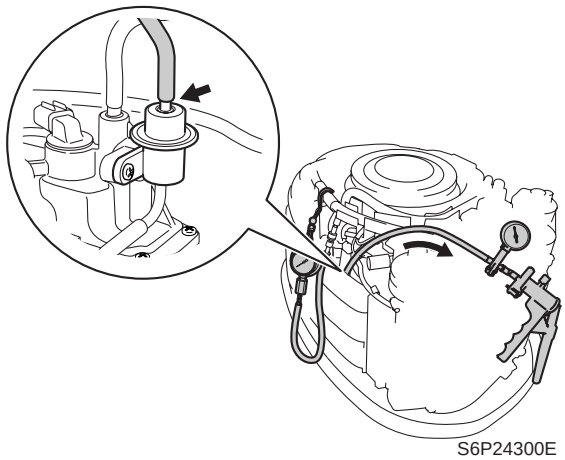
2. Disconnect the quick connector from the vapor separator.

NOTE:
To disconnect the quick connector, see Chapter 4, "Disconnecting the quick connector."

3. Connect fuel pressure gauge adapter B between the quick connector and vapor separator.

4. Connect the fuel pressure gauge to fuel pressure gauge adapter B.

5. Disconnect the pressure regulator hose, and then connect the special service tool to the pressure regulator.


S6P24300E

⚠ WARNING
- **Gently screw in the gauge until it is firmly connected to prevent fuel from leaking out.**
- **Before measuring the fuel pressure, make sure that the drain screw is tightened securely.**
- **Do not loosen the drain screw while measuring the fuel pressure. Loosening the drain screw can cause fuel to spray out creating a fire hazard.**

Fuel pressure gauge: 90890-06786
Fuel pressure gauge adapter B:
90890-06942
Vacuum/pressure pump gauge set:
90890-06756

6. Start the engine and let it idle.

7. Check that the fuel pressure is reduced when vacuum pressure is applied to the pressure regulator. If the fuel pressure is not reduced, replace the pressure regulator.

NOTE:
When the specified vacuum pressure is reached, the pressure regulator is operated and the fuel pressure is reduced.

8. Reduce the fuel pressure.

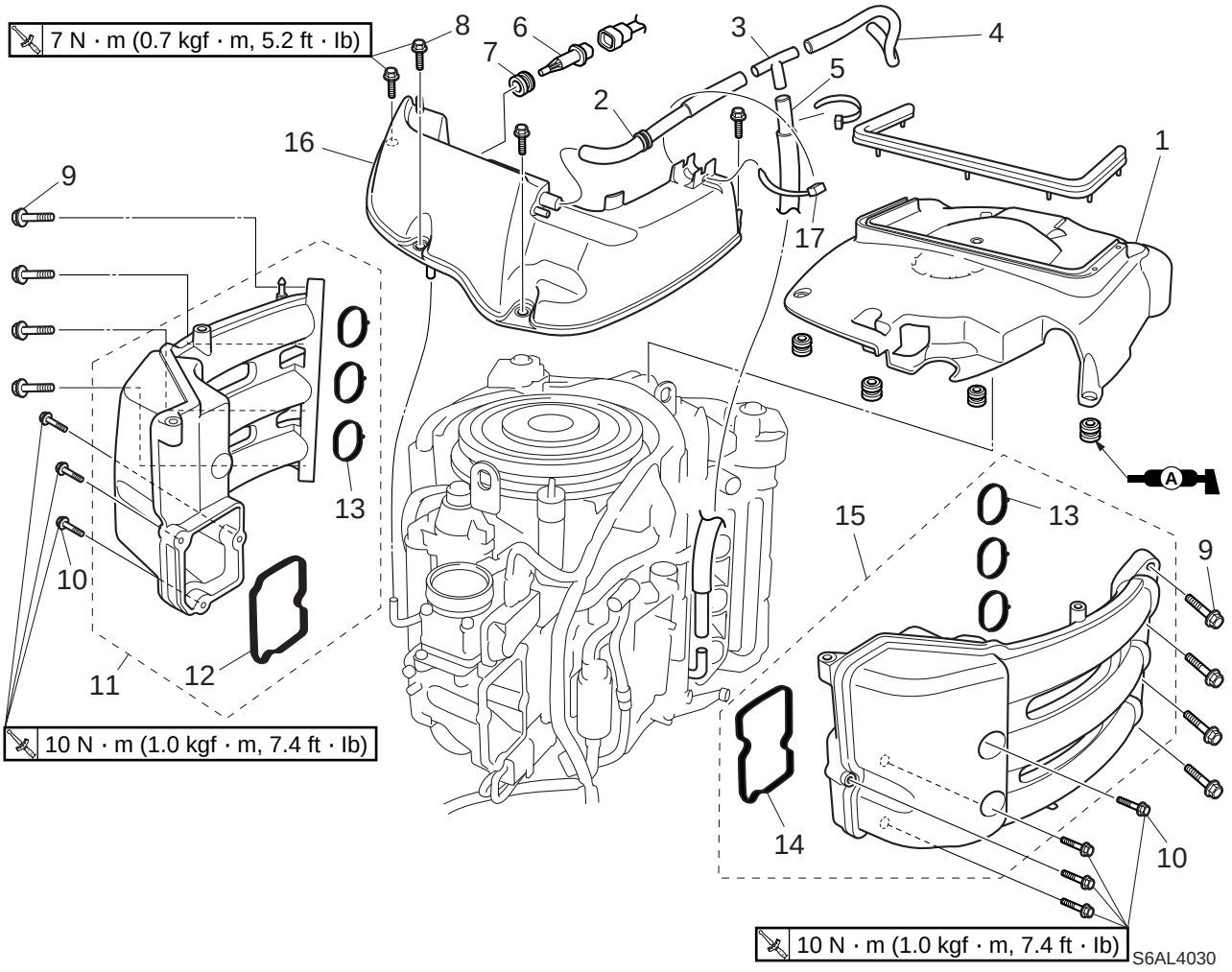
NOTE:
To reduce the fuel pressure, see Chapter 4, “Reducing the fuel pressure.”

9. Disconnect the special service tools.

⚠ WARNING
- **After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the drain screw to drain the remaining fuel from the hose and gauge.**
- **When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.**

10. Connect the pressure regulator hose and quick connector.

Intake manifold



No.	Part name	Q'ty	Remarks
1	Flywheel magnet cover	1	
2	Blowby hose	1	
3	Joint	1	
4	Blowby hose	1	
5	Blowby hose	1	
6	Intake air temperature sensor	1	
7	Grommet	1	
8	Bolt	4	M6 × 25 mm
9	Bolt	8	M8 × 40 mm
10	Bolt	7	M6 × 40 mm
11	Intake manifold (STBD)	1	
12	Gasket	1	**Not reusable**
13	Gasket	6	**Not reusable**
14	Gasket	1	**Not reusable**
15	Intake manifold (PORT)	1	
16	Intake silencer	1	
17	Plastic tie	1	

Checking the intake manifold

1. Check the intake manifold. Replace the intake manifold if cracked or deformed.

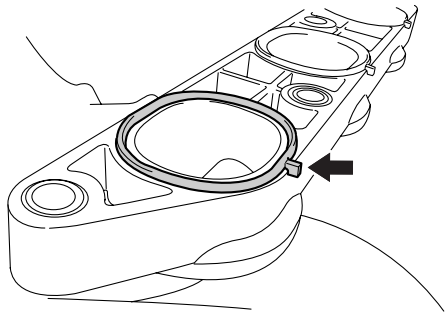
2. Check the intake silencer. Replace the intake silencer if cracked or deformed.

3. Check the blowby hoses. Replace the blowby hoses if cracked or damaged.

NOTE:
To check the intake air temperature sensor, see Chapter 8, "Checking the intake air temperature sensor."

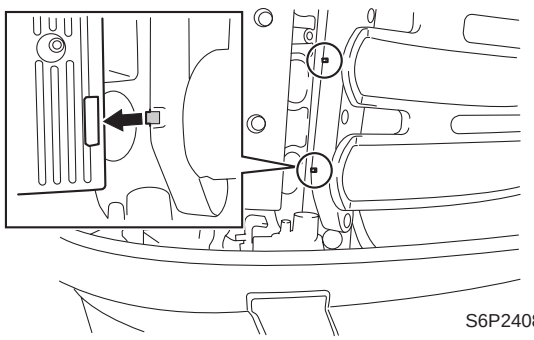
Installing the intake manifold

1. Install new gaskets onto the intake manifolds.


S6P24060

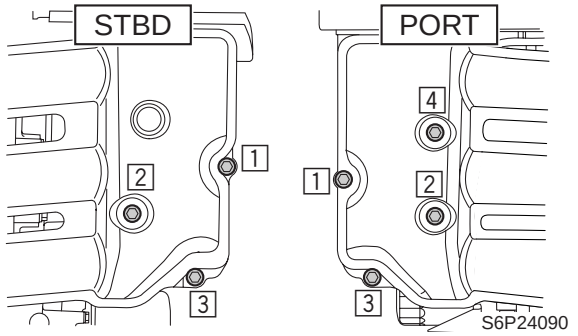
NOTE:
Be sure to install the projection on each gasket into its corresponding slit in the intake manifolds.

2. Install the intake manifolds and bolts temporarily.


S6P24080E

NOTE:
When installing the intake manifolds, make sure that the gaskets do not come off when the projection of the gasket comes into contact with the fuel rail cover.

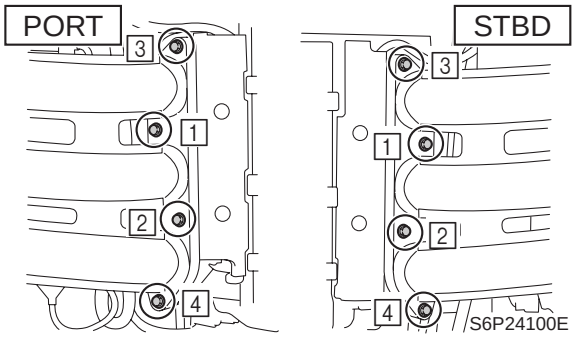
3. Tighten the intake manifold bolts (M6) to the specified torque in the sequence shown.



S6P24090

	Intake manifold bolt (M6): 10 N·m (1.0 kgf·m, 7.4 ft·lb)

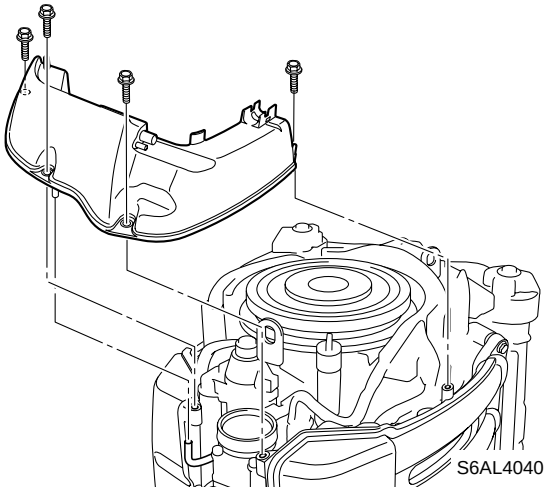
4. Tighten the intake manifold bolts (M8) in the sequence shown.



S6P24100E

Installing the intake silencer

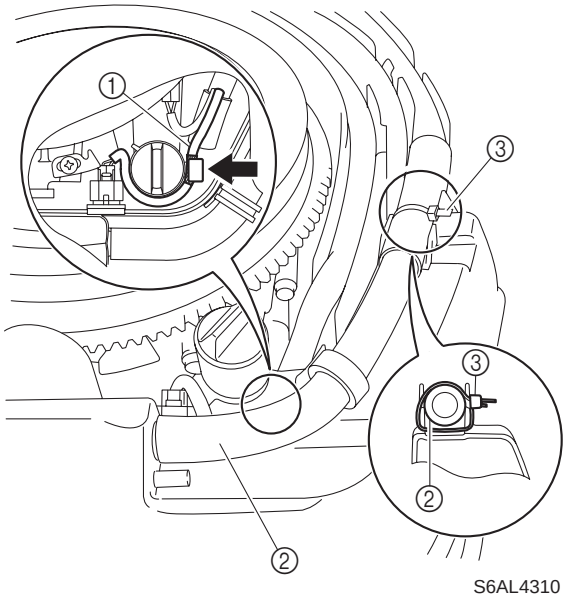
1. Install the intake silencer.



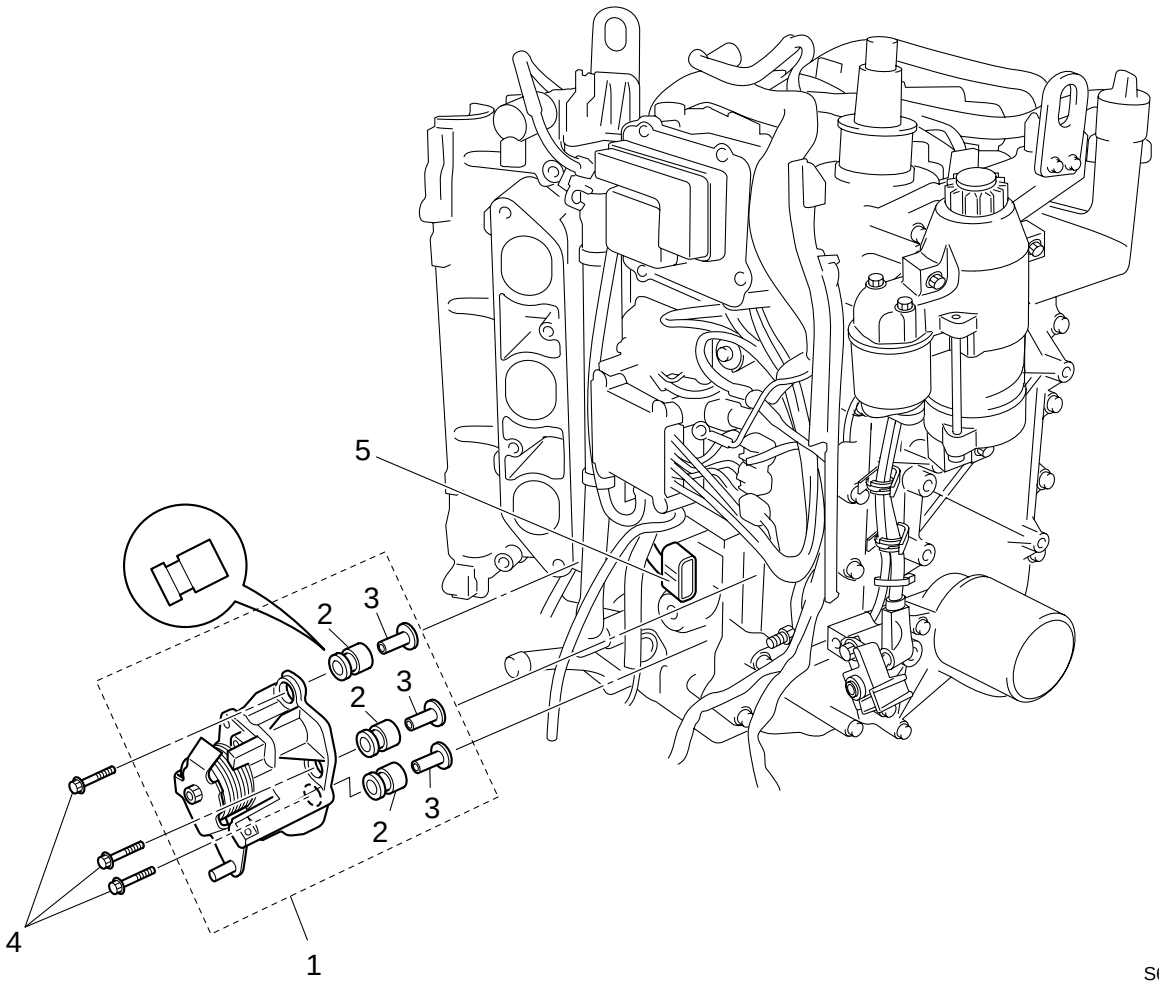
Intake silencer bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

2. Fasten the intake air temperature sensor lead ① to the holder on the oil filler neck as shown.

3. Connect the blowby hose ②, and then fasten the plastic tie ③ as shown.



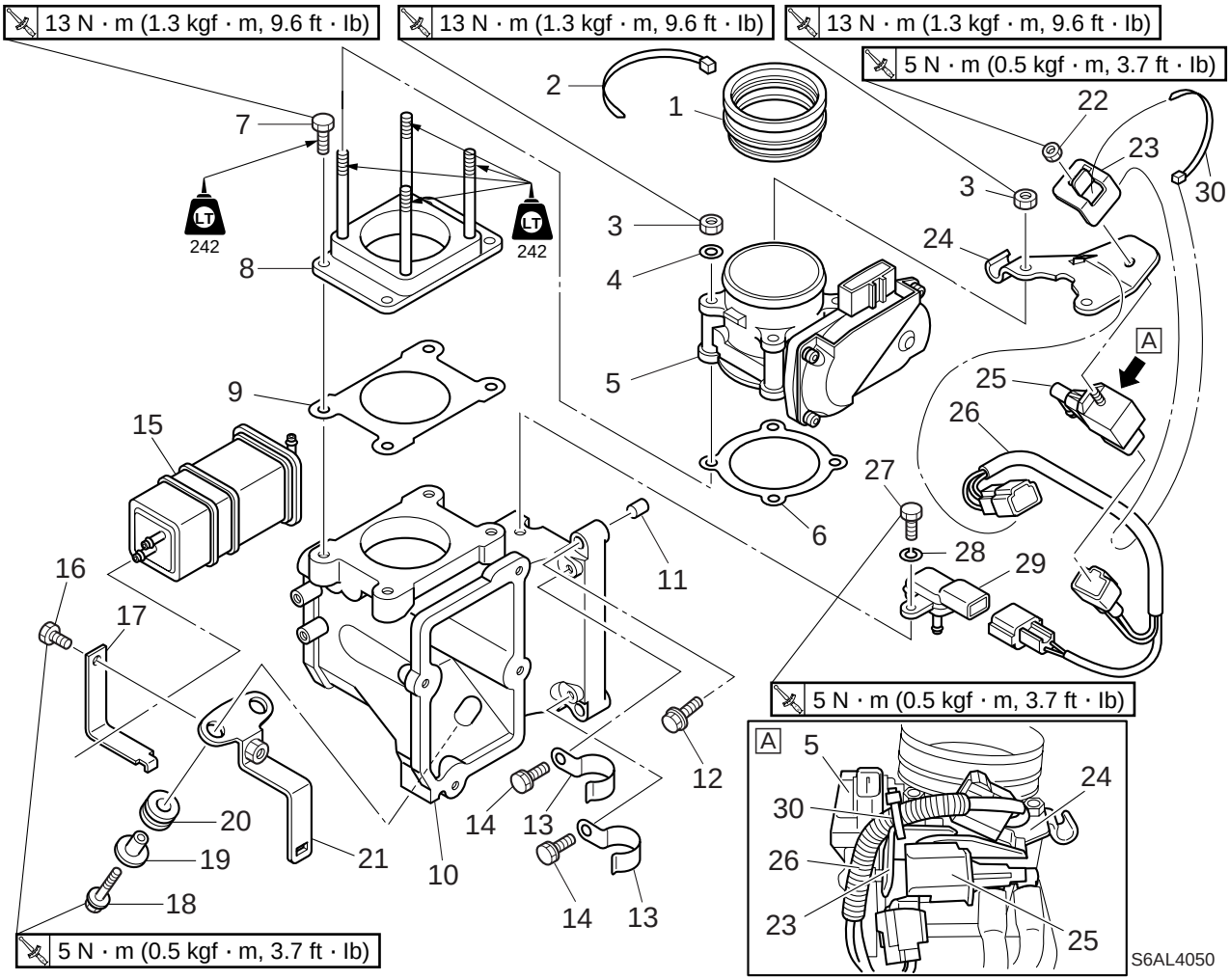
Accelerator position sensor



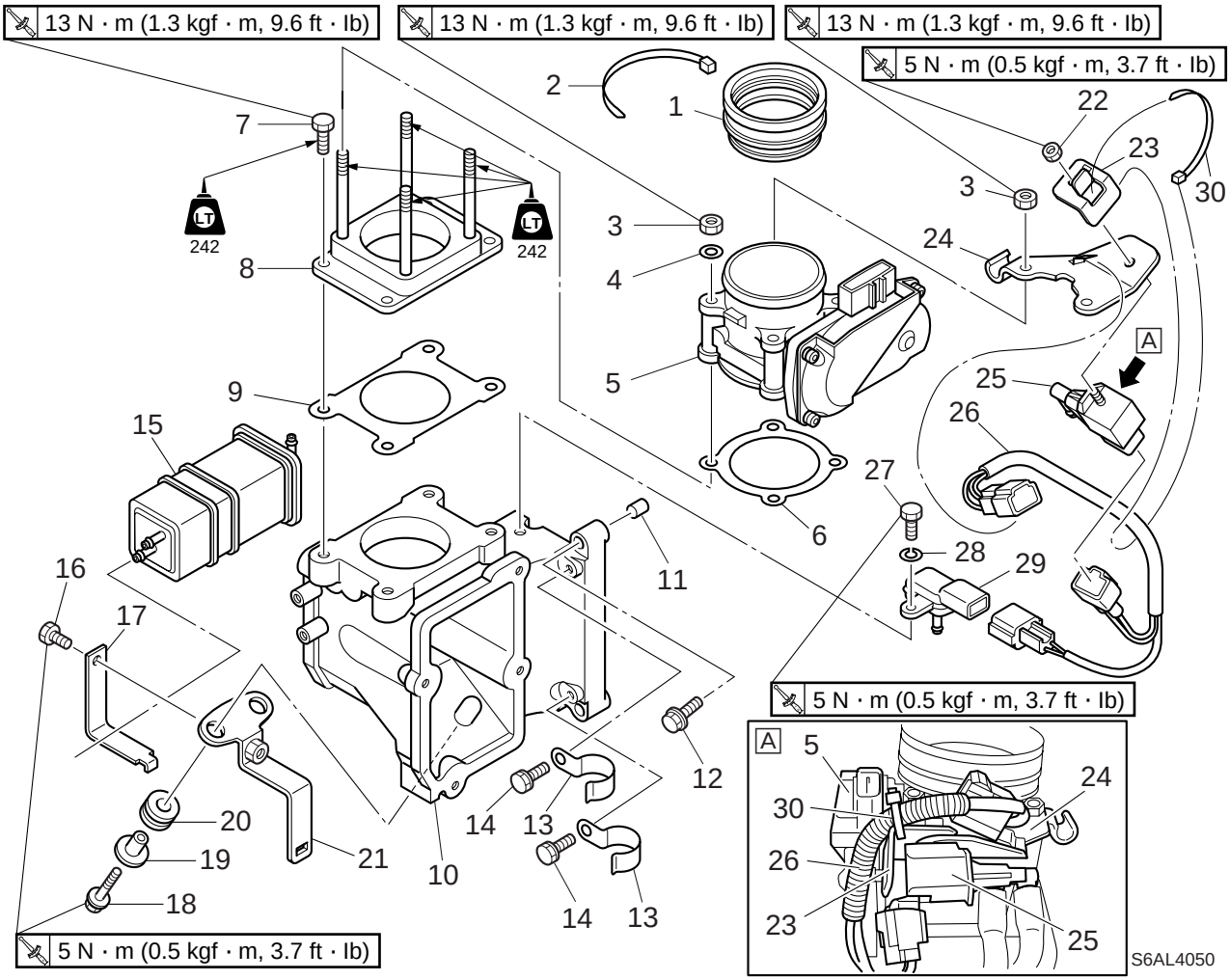
S6AL4300

No.	Part name	Q'ty	Remarks
1	Accelerator position sensor assembly	1	
2	Grommet	3	
3	Collar	3	
4	Bolt	3	M6 × 35 mm
5	Accelerator position sensor coupler	1	

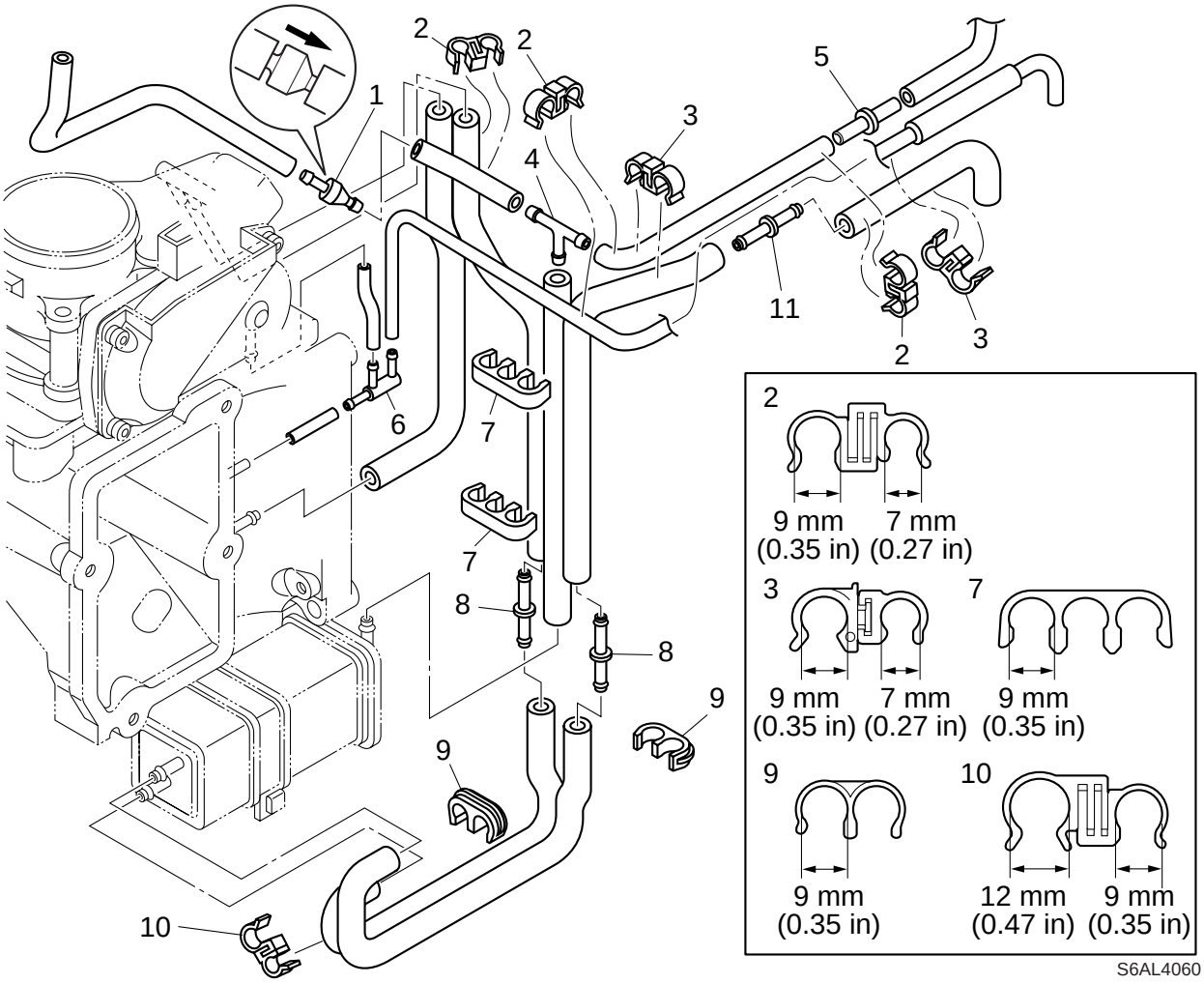
Throttle body



No.	Part name	Q'ty	Remarks
1	Joint	1	
2	Plastic tie	1	
3	Nut	4	
4	Washer	2	
5	Electronic throttle valve assembly	1	
6	Gasket	1	**Not reusable**
7	Bolt	4	M8 × 18 mm
8	Plate	1	
9	Gasket	1	**Not reusable**
10	Surge tank	1	
11	Collar	2	
12	Bolt	4	M8 × 40 mm
13	Holder	2	
14	Bolt	2	M6 × 16 mm
15	Canister	1	
16	Bolt	1	M6 × 10 mm
17	Bracket	1	



No.	Part name	Q'ty	Remarks
18	Bolt	2	M6 × 28 mm
19	Collar	2	
20	Grommet	2	
21	Bracket	1	
22	Nut	1	
23	Holder	1	
24	Bracket	1	
25	Vapor shut-off valve	1	
26	Sub wiring harness	1	
27	Bolt	1	M6 × 20 mm
28	Washer	1	
29	Intake air pressure sensor	1	
30	Plastic tie	1	**Not reusable**



No.	Part name	Q'ty	Remarks
1	Check valve	1	
2	Holder	3	
3	Holder	2	
4	Joint	1	
5	Joint	1	ø3 mm
6	Joint	1	
7	Holder	2	
8	Joint	2	ø5 mm
9	Holder	2	
10	Holder	1	
11	Joint	1	ø5 mm

Checking the electronic throttle valve system

1. For checks related to the APS and TPS, see Chapter 8.

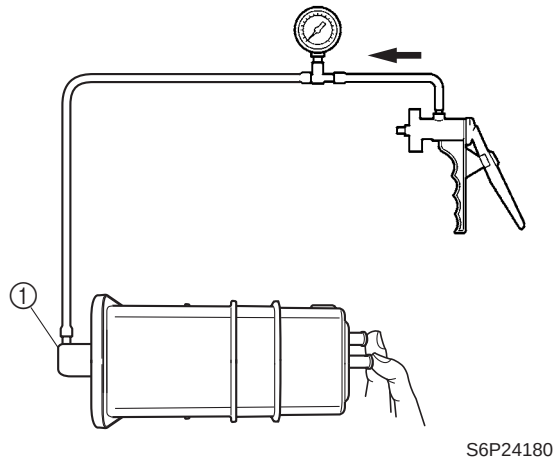
NOTE:

- To check the electronic throttle valve assembly, see Chapter 8, “ECM and electronic throttle valve control system.”
- To check the vapor shut-off valve, see Chapter 8, “Checking the vapor shut-off valve.”
- To check the electronic throttle valve relay, see Chapter 8, “Checking the main relay and electronic throttle valve relay.”
- To check the intake air pressure sensor, see Chapter 8, “Checking the intake air pressure sensor.”
- To check the fuse, see Chapter 8, “Fuse holder.”

Checking the canister

1. Check the canister. Replace the canister if cracked.

2. Connect the special service tool to the atmospheric port ① and cover the other ports, each with a finger.



S6P24180

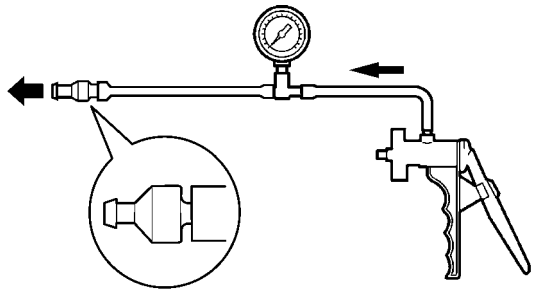
3. Apply the specified positive pressure and check that there is no air leakage. Replace the canister if there is air leakage.

Vacuum/pressure pump gauge set:
90890-06756

Specified pressure:
19.6 kPa (0.196 kgf/cm^2, 2.8 psi)

Checking the canister check valve

1. Connect the special service tool to the check valve port as shown.

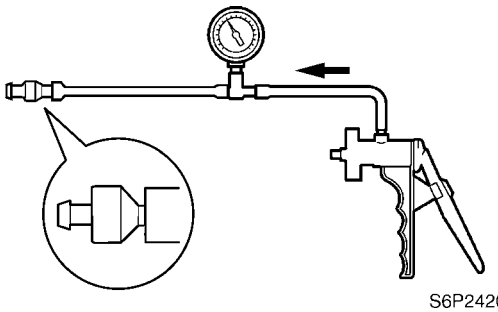

S6P24190

Vacuum/pressure pump gauge set:
90890-06756

2. Apply positive pressure to the check valve port.

3. Check that air comes out of the opposite end of the check valve. Replace the canister check valve if no air comes out.

4. Connect the special service tool to the opposite check valve port as shown.

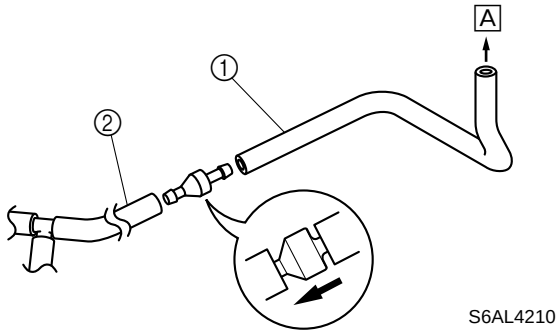

S6P24200

5. Apply positive pressure to the check valve port.

6. Check that no air comes out of the opposite end of the check valve. Replace the canister check valve if air comes out.

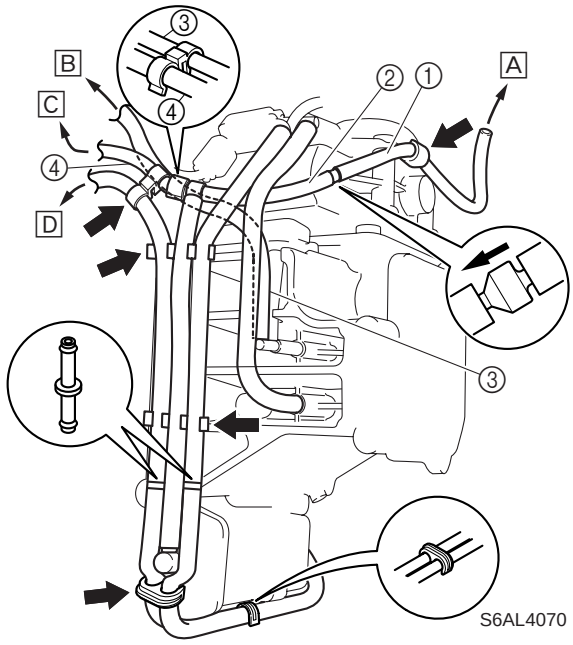
Installing the throttle body

1. Connect the check valve to the hoses ① and ②.



A To the intake silencer

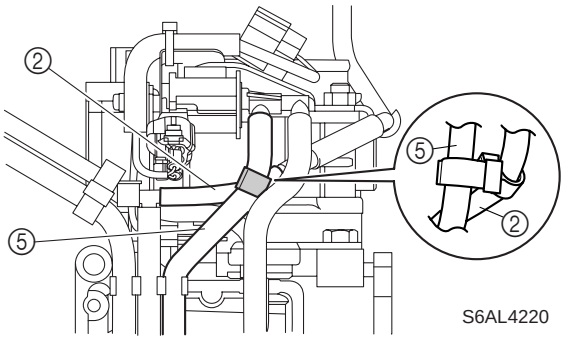
2. Connect the hoses and fasten them.



A To the intake silencer
B To the pressure regulator
C To the atmosphere (top cowling lock)
D To the vapor separator

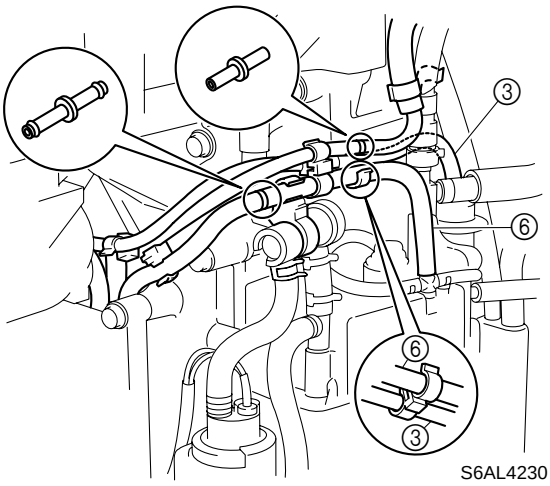
NOTE:
Fasten the pressure regulator hose ③ and canister vent hose ④ to the holder.

3. Fasten the hoses ② and ⑤ to the holder.



4. Install the throttle body.

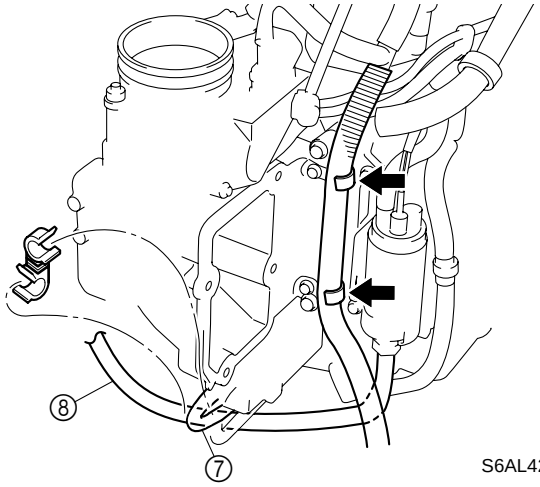
5. Connect the hoses and fasten them.



NOTE:
Fasten the pressure regulator hose ③ and vapor separator hose ⑥ to the holder.

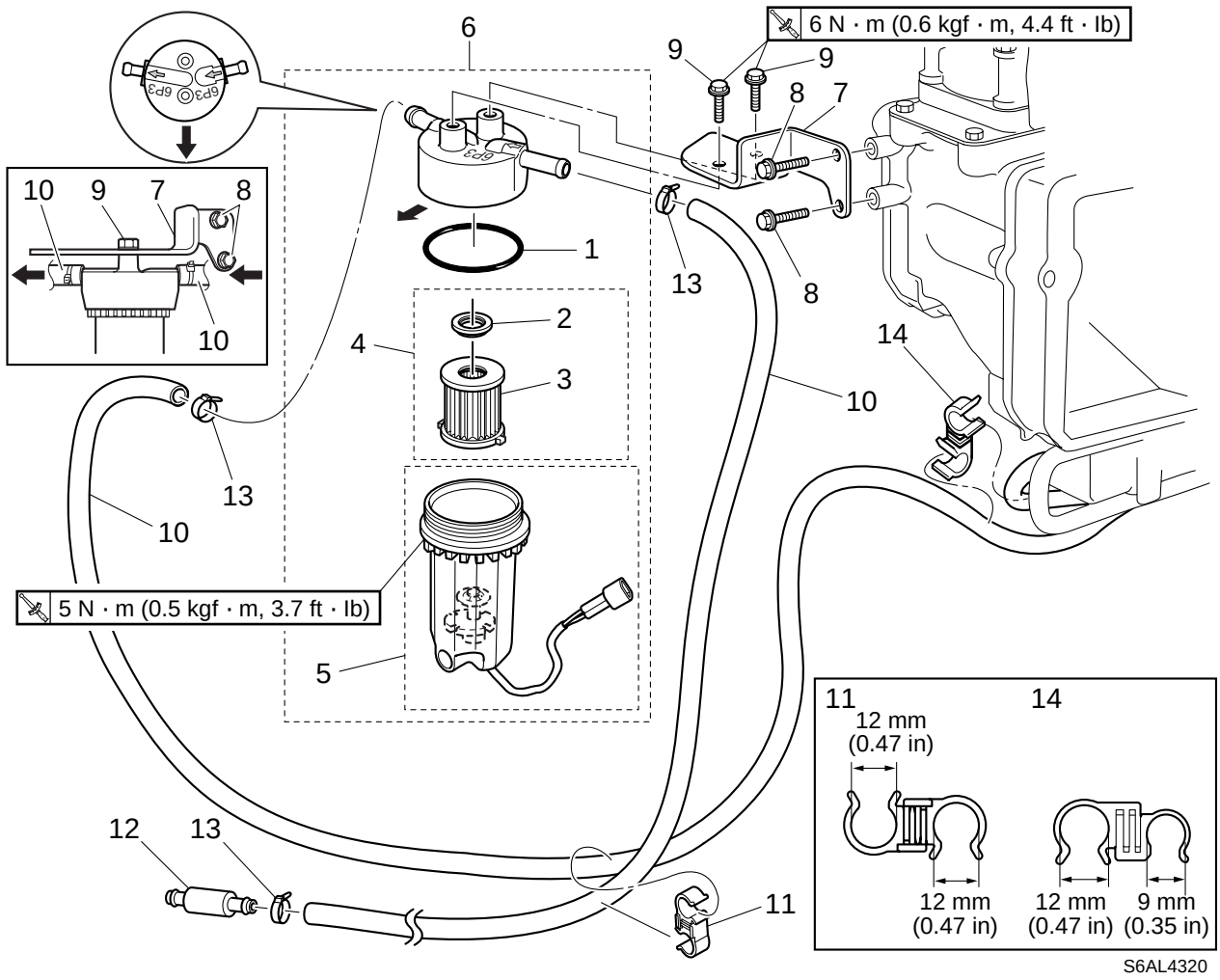
6. Fasten the wiring harness to the holders.

7. Fasten the vapor gas hose ⑦ and fuel hose ⑧ to the holder.



S6AL4240

Fuel filter



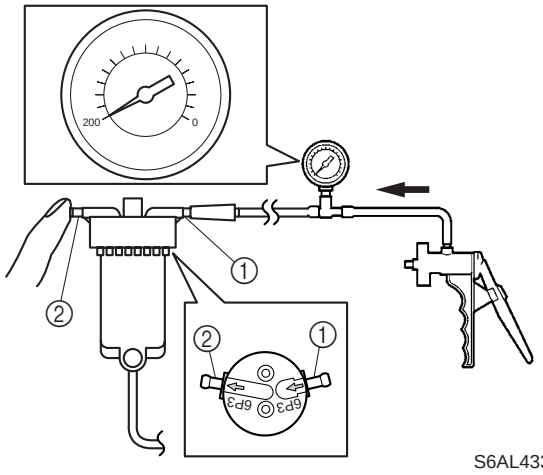
No.	Part name	Q'ty	Remarks
1	O-ring	1	**Not reusable**
2	Grommet	1	**Not reusable**
3	Fuel filter element	1	
4	Fuel filter element assembly	1	
5	Fuel cup assembly	1	
6	Fuel filter assembly	1	
7	Bracket	1	
8	Bolt	2	M6 × 16 mm
9	Bolt	2	M6 × 14 mm
10	Fuel hose	2	
11	Holder	1	
12	Joint	1	
13	Plastic tie	3	**Not reusable**
14	Holder	1	

Checking the fuel filter assembly

NOTE:
- To check the fuel filter element, see Chapter 3, “Checking the fuel filter.”
- To check the water detection switch, see Chapter 8, “Checking the water detection switch.”

1. Connect a vacuum/pressure pump gauge and a meter to the fuel inlet ①.

2. Cover the fuel outlet ② with a finger, and then apply the specified positive pressure. Replace the O-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for at least 15 seconds.



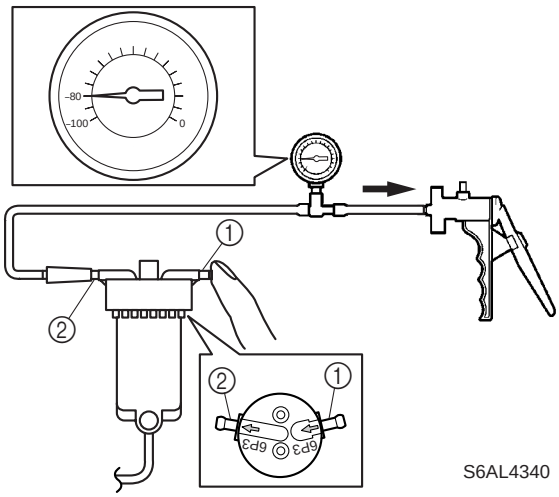
S6AL4330

NOTE:
Use a commercially available vacuum/pressure pump gauge and meter that can be pressurized up to 200 kPa (2.0 kgf/cm^2, 29.0 psi).

Specified positive pressure:
200 kPa (2.0 kgf/cm^2, 29.0 psi)

3. Connect a vacuum/pressure pump gauge and a meter to the fuel outlet ②.

4. Cover the fuel inlet ① with a finger, and then apply the specified negative pressure. Replace the O-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for at least 15 seconds.



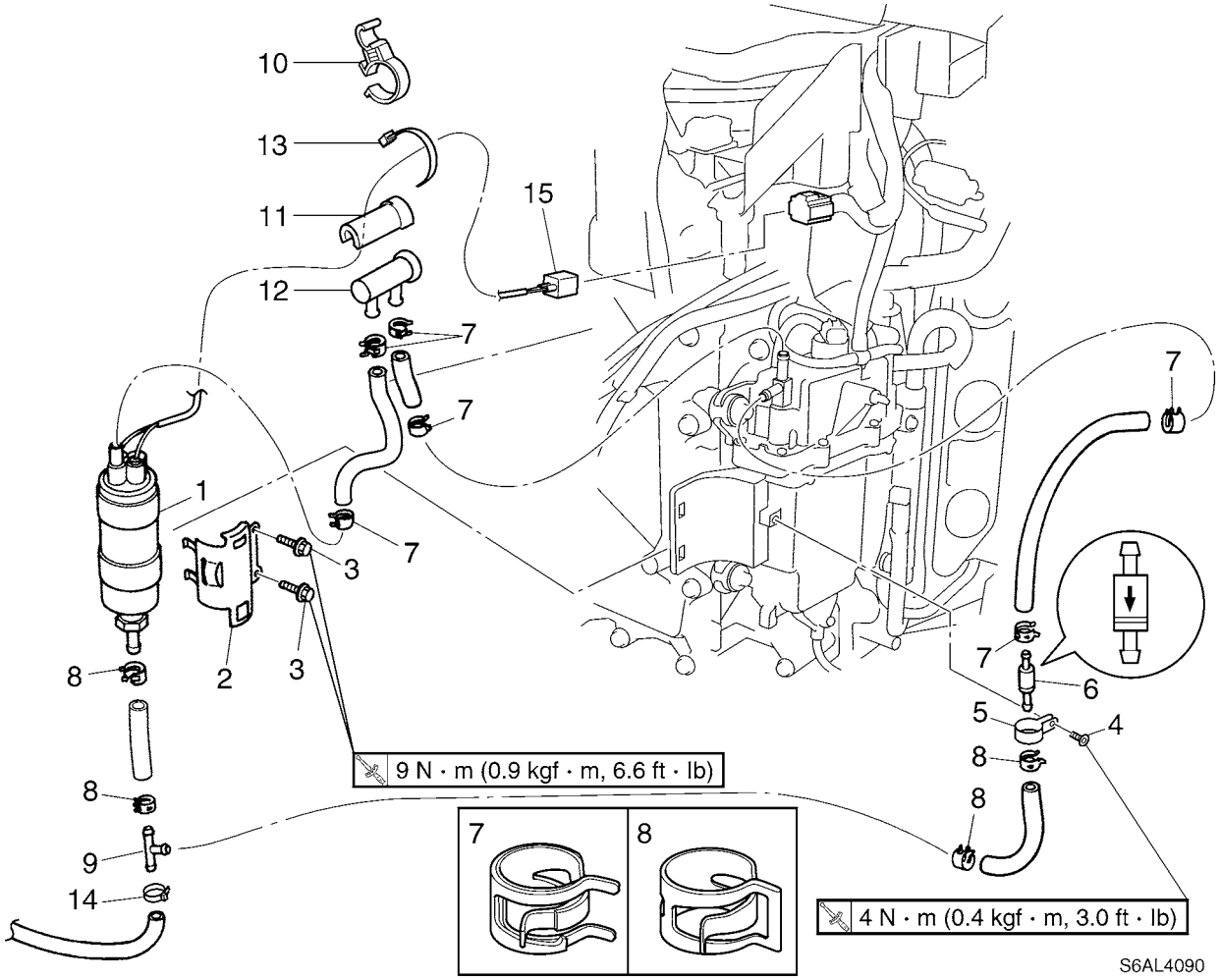
S6AL4340

NOTE:
Use a commercially available vacuum/pressure pump gauge and meter that can be depressurized down to 80 kPa (0.8 kgf/cm^2, 11.6 psi).

Specified negative pressure:
80 kPa (0.8 kgf/cm^2, 11.6 psi)

4

Low-pressure fuel pump



No.	Part name	Q'ty	Remarks
1	Low-pressure fuel pump	1	
2	Cover	1	
3	Bolt	2	M6 × 15 mm
4	Screw	1	ø5 × 8 mm
5	Holder	1	
6	Check valve	1	
7	Clamp	6	
8	Clamp	4	
9	Joint	1	
10	Holder	1	
11	Cover	1	
12	Fuel filter	1	
13	Plastic tie	1	**Not reusable**
14	Plastic tie	1	**Not reusable**
15	Low-pressure fuel pump coupler	1	

Checking the low-pressure fuel pump

1. Drain the fuel from the vapor separator and check the condition of the fuel.

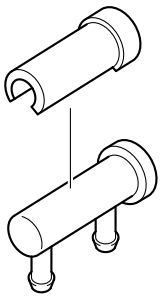
NOTE:
- To drain the fuel, see Chapter 3, “Draining the fuel.”
- If the fuel is dirty, check and clean the fuel lines.

2. Check the low-pressure fuel pump.

NOTE:
- To check the low-pressure fuel pump, see Chapter 8, “Checking the low-pressure fuel pump and high-pressure fuel pump.”
- To check the fuse, see Chapter 8, “Fuse holder.”

Checking the fuel filter

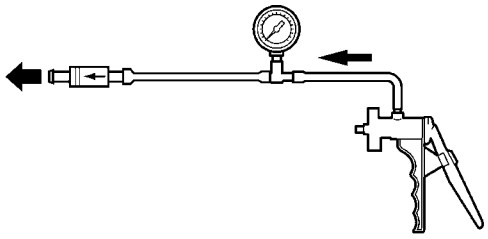
1. Check the fuel filter. Replace the fuel filter if there is dirt, residue, or external damage.



S6AL4260

Checking the check valve

1. Connect the special service tool to the check valve port as shown.



S6P24220

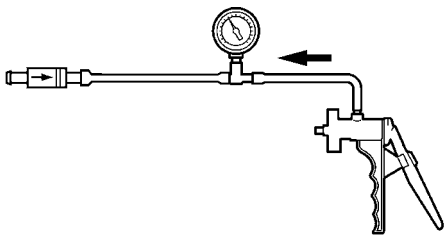


Vacuum/pressure pump gauge set:
90890-06756

2. Apply positive pressure to the check valve port.

3. Check that air comes out of the opposite end of the check valve. Replace the check valve if no air comes out.

4. Connect the special service tool to the opposite check valve port as shown.

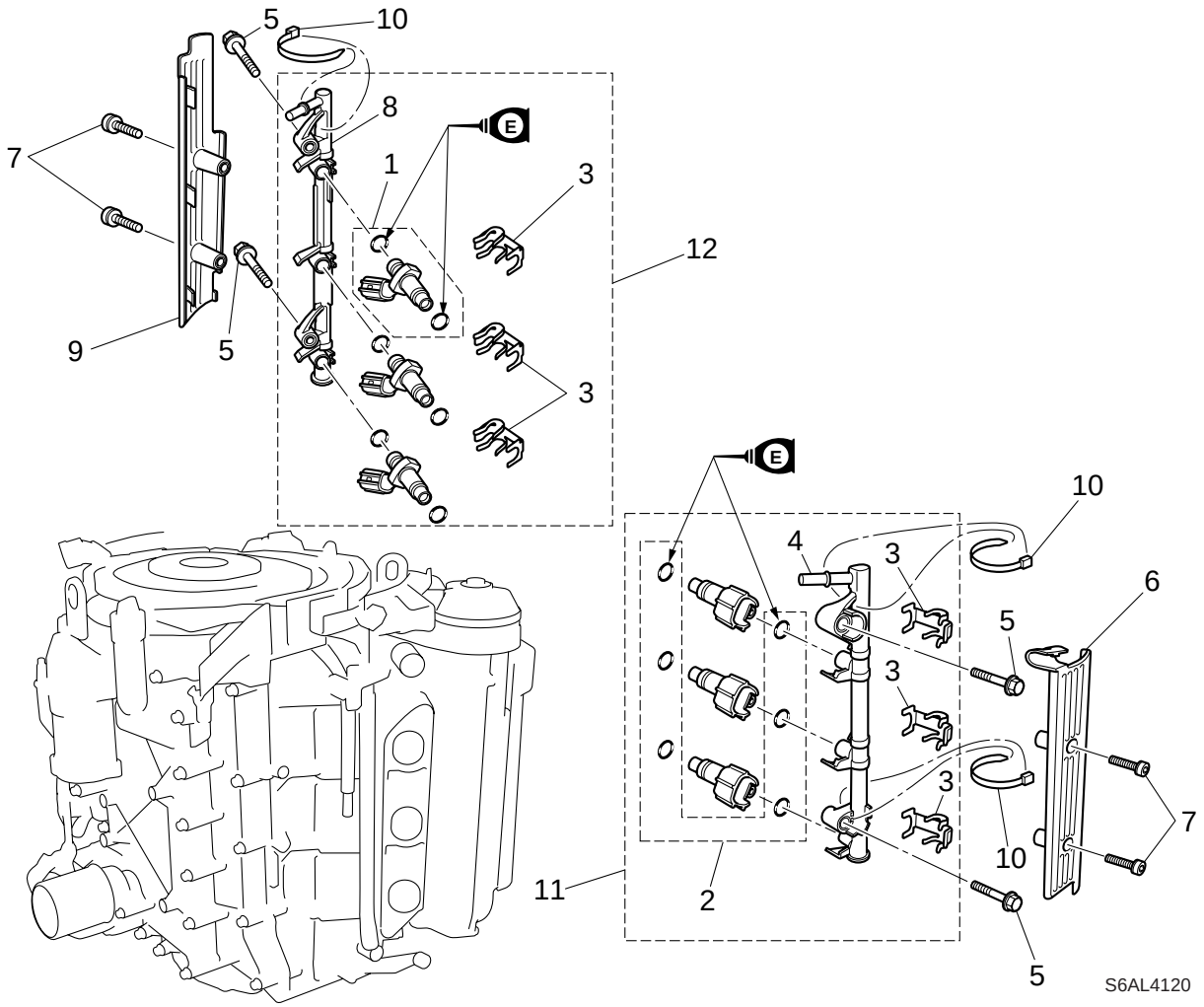


S6P24230

5. Apply positive pressure to the check valve port.

6. Check that no air comes out of the opposite end of the check valve. Replace the check valve if air comes out.

Fuel injector



No.	Part name	Q'ty	Remarks
1	Fuel injector	6	
2	O-ring set	2	**Not reusable**
3	Holder	6	
4	Fuel rail (PORT)	1	
5	Bolt	4	M6 × 35 mm
6	Cover	1	
7	Bolt	4	M6 × 20 mm
8	Fuel rail (STBD)	1	
9	Cover	1	
10	Plastic tie	3	
11	Fuel rail assembly (PORT)	1	
12	Fuel rail assembly (STBD)	1	

Checking the fuel rail

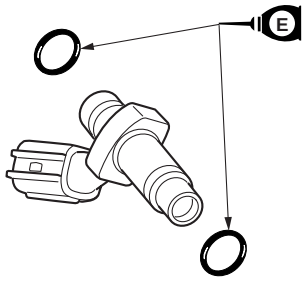
1. Check the fuel rails. Replace the fuel rail if cracked or deformed.

NOTE:

- To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."
- To check the fuel injectors, see Chapter 8, "Checking the fuel injector."

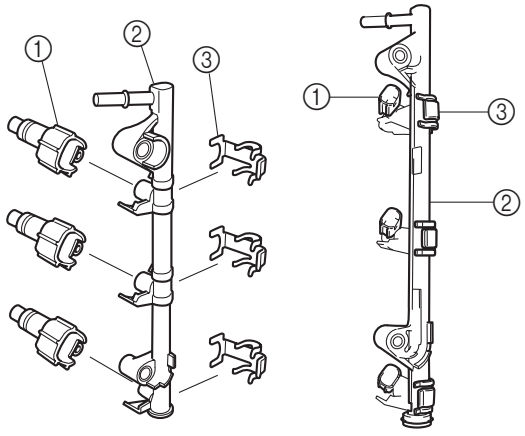
Installing the fuel injector

1. Apply engine oil to new O-rings, and then install them onto the fuel injectors.



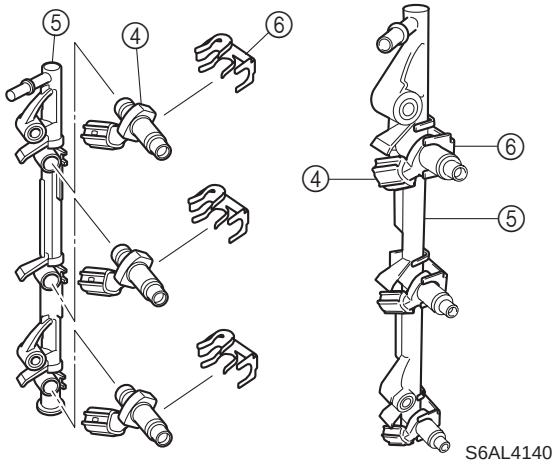
S6P24330

2. Install the fuel injectors ① onto the port fuel rail ②, and then install the holders ③ as shown.



S6AL4130

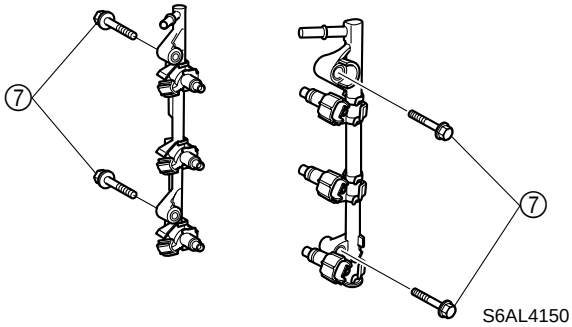
3. Install the fuel injectors ④ onto the starboard fuel rail ⑤, and then install the holders ⑥ as shown.



S6AL4140

4. Install the fuel rails onto the cylinder heads.

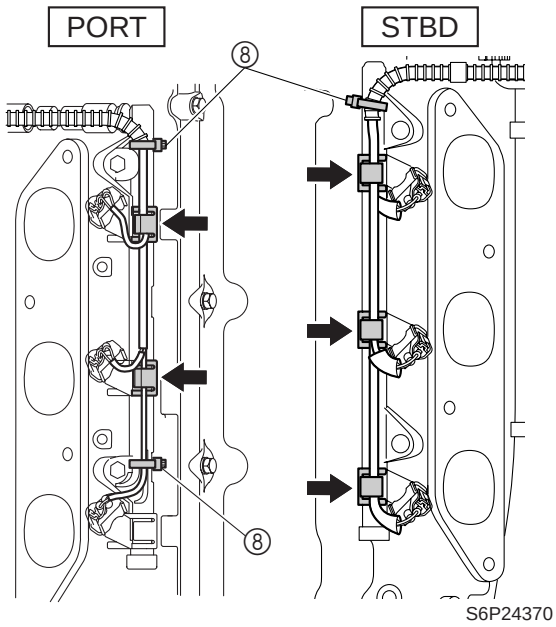
5. Tighten the bolts ⑦ equally and gradually.



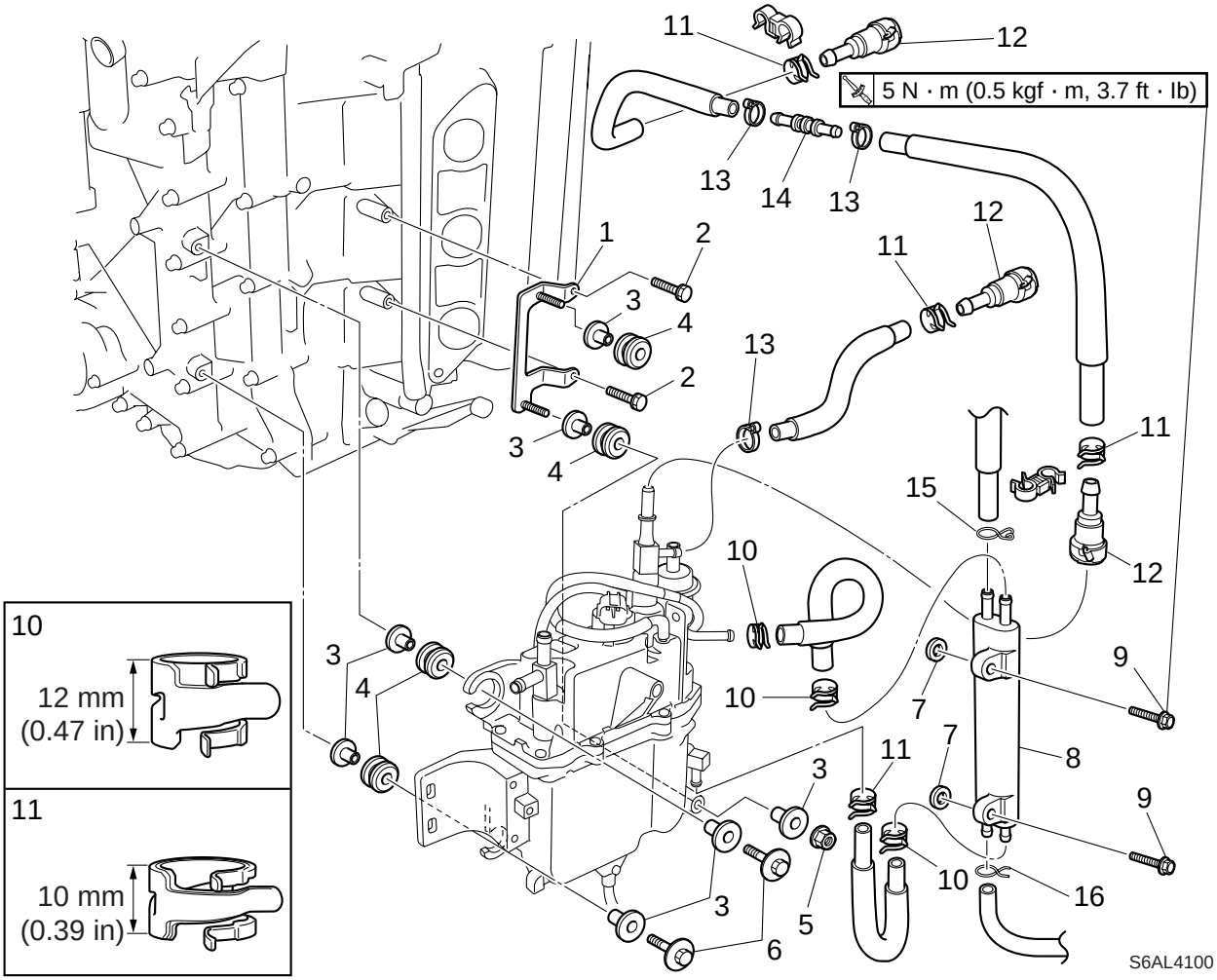
S6AL4150

6. Connect the fuel injector couplers.

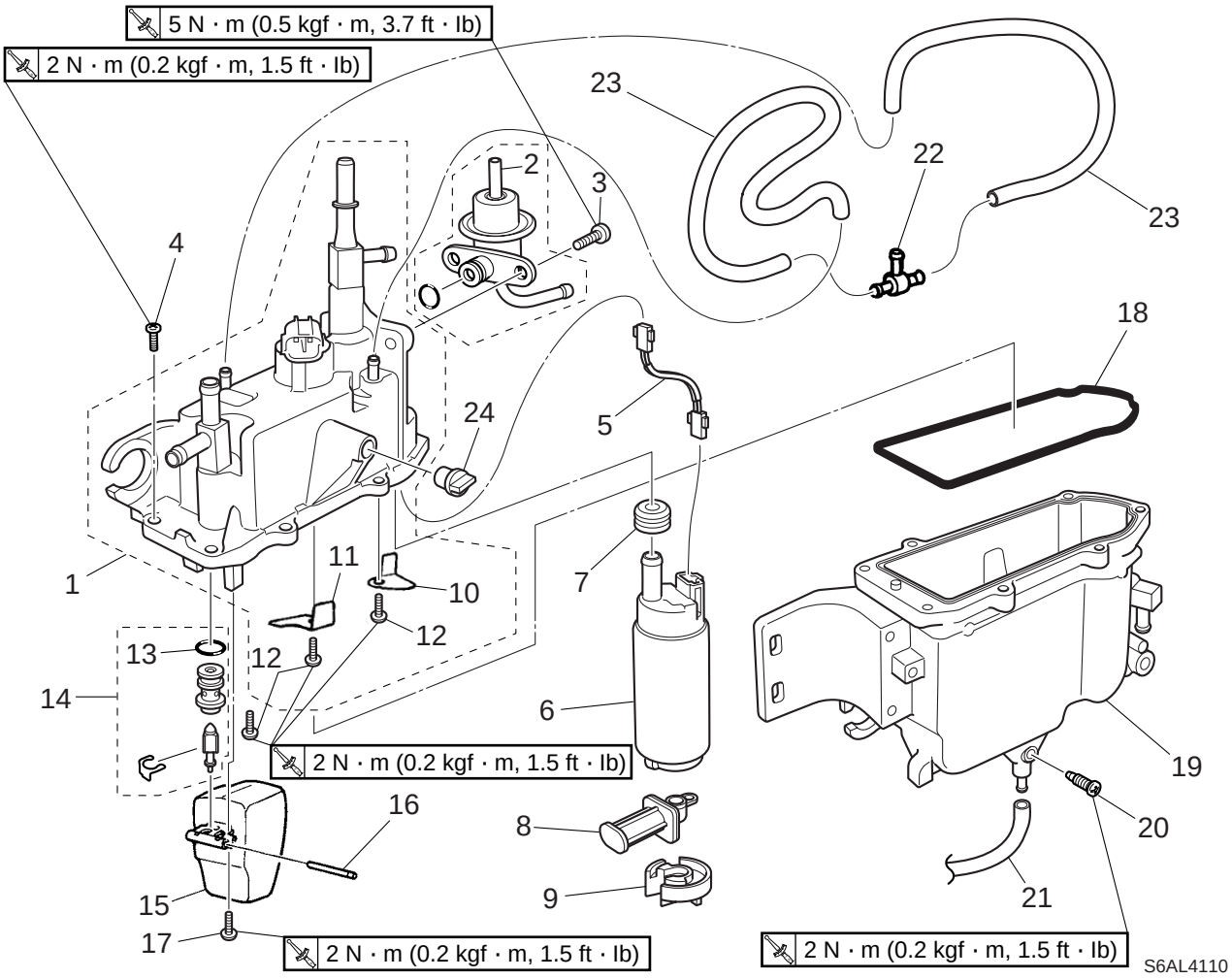
7. Fasten the wiring harness to the holders, and then fasten the plastic ties ⑧ as shown.



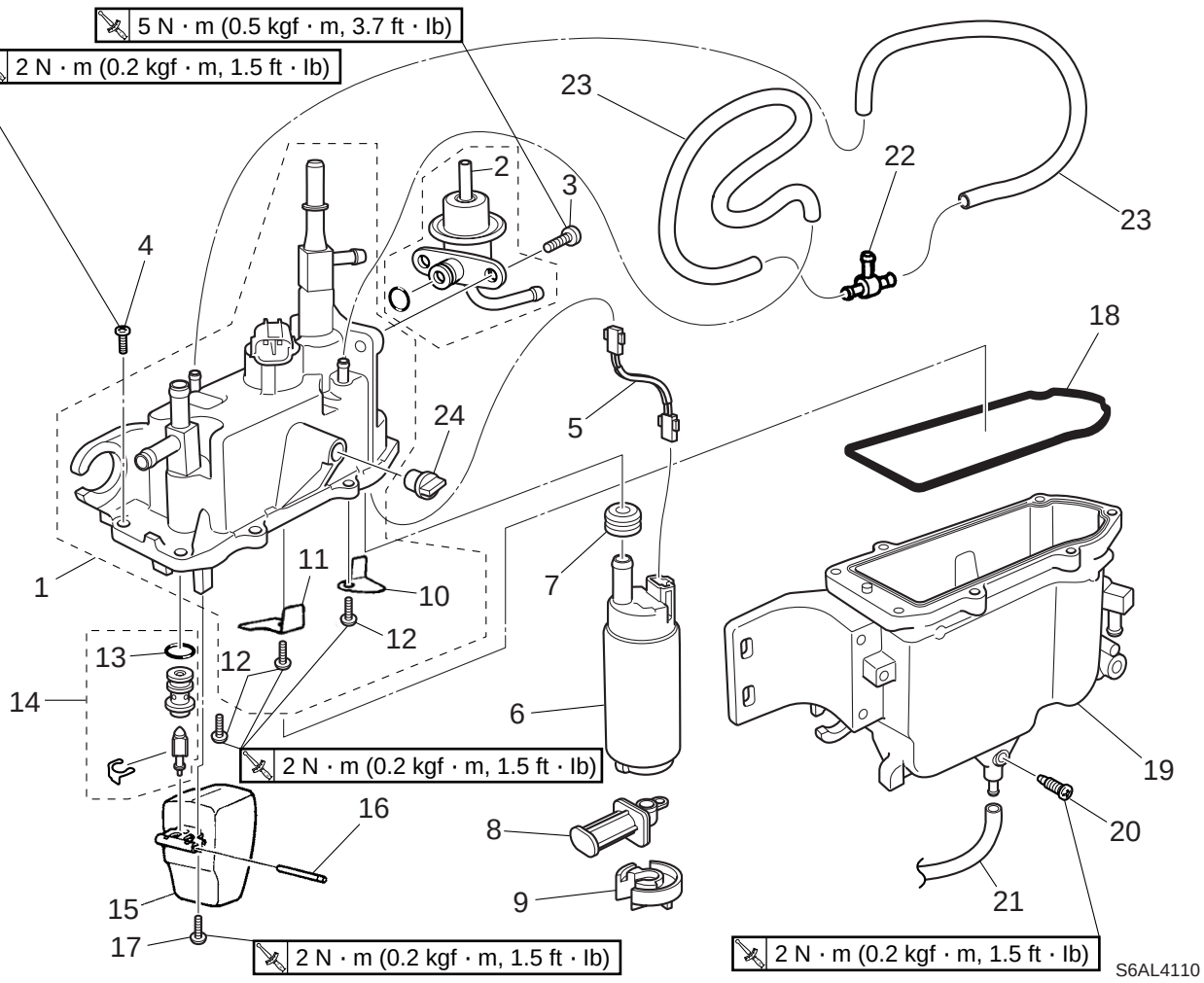
Vapor separator



No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Bolt	2	M6 × 16 mm
3	Collar	8	
4	Grommet	4	
5	Nut	2	
6	Bolt	2	M6 × 35 mm
7	Collar	2	
8	Fuel cooler	1	
9	Bolt	2	M6 × 25 mm
10	Clamp	3	
11	Clamp	4	
12	Quick connector	3	
13	Clamp	3	**Not reusable**
14	Joint	1	
15	Clamp	1	
16	Clamp	1	



No.	Part name	Q'ty	Remarks
1	Cover assembly	1	
2	Pressure regulator	1	
3	Screw	2	ø6 × 12 mm
4	Screw	7	ø4 × 16 mm
5	Wiring harness	1	
6	High-pressure fuel pump	1	
7	Grommet	1	
8	Filter	1	
9	Filter holder	1	
10	Plate	1	
11	Plate	1	
12	Screw	3	ø4 × 8 mm
13	O-ring	1	**Not reusable**
14	Needle valve assembly	1	
15	Float	1	
16	Pin	1	
17	Screw	1	ø4 × 8 mm

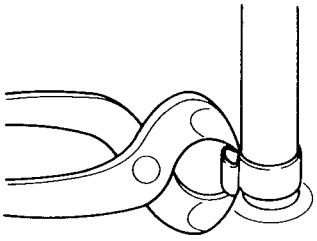


No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Float chamber	1	
20	Vapor separator drain screw	1	
21	Drain hose	1	
22	Joint	1	
23	Hose	2	
24	Cap	1	

Removing the fuel hose clamp

NOTE:
To reduce the fuel pressure, see Chapter 4, “Reducing the fuel pressure.”

1. Remove the fuel hose clamps by cutting the crimped section of the clamp.

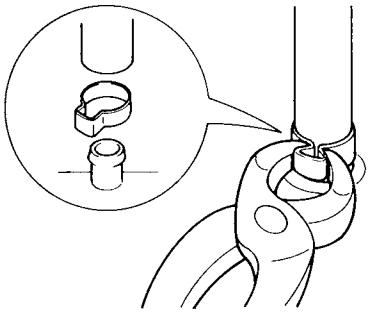


S69J4030

CAUTION:
If the fuel hose clamps are removed without cutting the crimp first, the fuel hose could be damaged.

Installing the fuel hose clamp

1. Crimp the fuel hose clamps properly to securely fasten them.



S69J4040

⚠ WARNING
Do not reuse the fuel hose clamps, always replace them with new ones, otherwise the fuel leakage may occur.

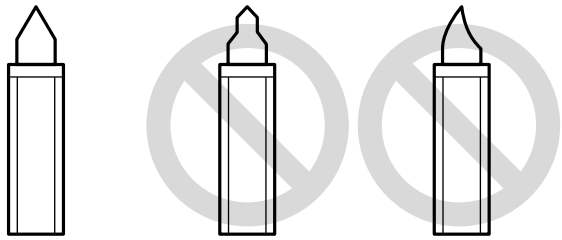
Checking the high-pressure fuel pump

NOTE:
- To check the high-pressure fuel pump, see Chapter 8, “Checking the low-pressure fuel pump and high-pressure fuel pump.”
- To check the high-pressure fuel pump relay, see Chapter 8, “Checking the high-pressure fuel pump relay.”
- To check the fuse, see Chapter 8, “Fuse holder.”

Checking the vapor separator

NOTE:
To drain the fuel, see Chapter 3, “Draining the fuel.”

1. Check the needle valve. Replace needle valve assembly if bent or worn.



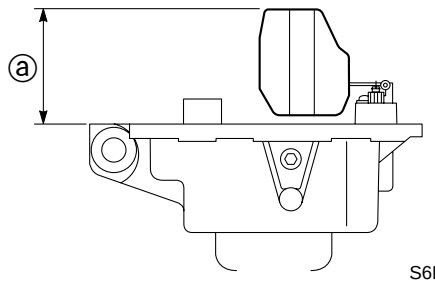
S6AL4350

2. Check the float. Replace the float if there is deterioration.

3. Check the filter. Clean the filter if there is dirt or residue.

4. Install the needle valve and float to the vapor separator cover.

5. Place the vapor separator cover assembly in the position shown in the illustration, and then measure the float height ⓐ.



NOTE:
To measure the height of the float, it should be resting on the needle valve. Do not press the float.

Float height ⓐ:
60.5 ± 3.0 mm (2.38 ± 0.12 in)

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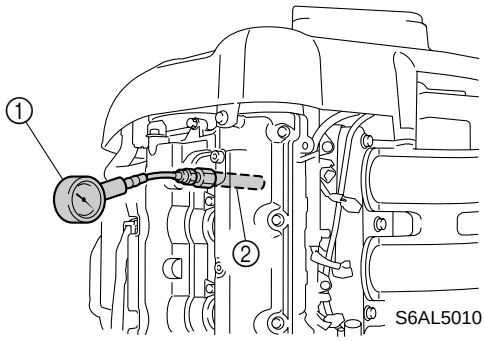
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Power unit (check and adjustment)

Checking the compression pressure

1. Start the engine, warm it up for 5 minutes, and then turn it off.
2. Remove the engine stop lanyard from the engine stop lanyard switch.
3. Disconnect all fuel injector couplers.
4. Remove the ECM cover, all ignition coils and spark plugs, and then install the special service tools into a spark plug hole.

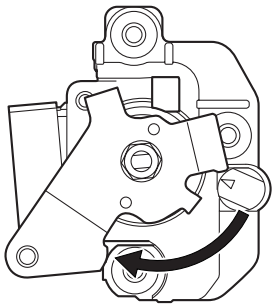


CAUTION:

Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.

Compression gauge ①:
90890-03160
Compression gauge extension ②:
90890-06563

5. Disconnect the throttle cable joint from the accelerator lever, and then place and hold the lever in the fully open position of the throttle.



6. Crank the engine until the reading on the compression gauge stabilizes, and then measure the compression pressure.

Minimum compression pressure (reference data):
740 kPa (7.4 kgf/cm^2, 107.3 psi)

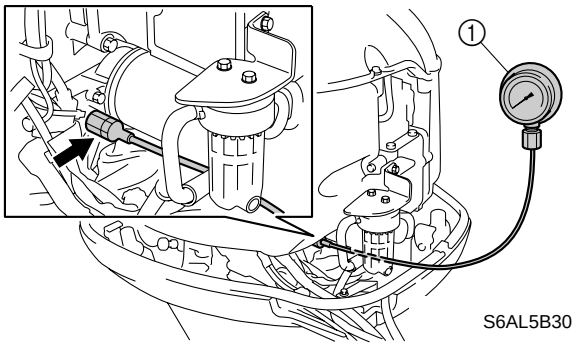
7. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then measure the compression pressure again.

NOTE:

- If the compression pressure increases, check the pistons and piston rings. Replace if worn.
- If the compression pressure does not increase, check the valve clearances, valves, valve seats, cylinder head gaskets, and cylinder heads. Adjust or replace if necessary.

Checking the oil pressure

1. Place a rag under the oil pressure sensor.
2. Remove the oil pressure sensor, and then install an oil pressure gauge ① into the oil pressure sensor installation hole.



NOTE:
- The intake manifold (STBD), positive battery cable, positive battery terminal, and holder (oil pressure sensor lead, isolator lead, and PTT lead) must be removed before removing the oil pressure sensor.
- Use a general oil pressure gauge ①.

3. Start the engine and warm it up for 5 minutes.

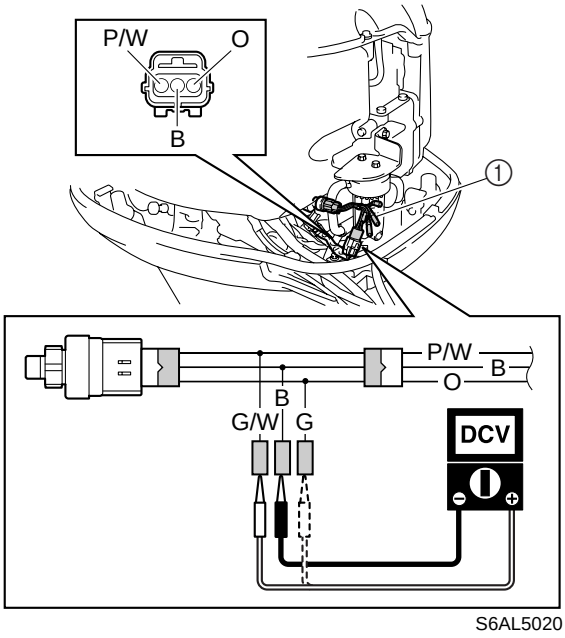
4. Measure the oil pressure. Check for oil leakage and check the oil pump and oil strainer if out of specification.

NOTE:
- If the engine is started with the coupler disconnected from the oil pressure sensor, the ECM will determine that an oil pressure sensor malfunction (trouble code 39) has occurred and increase the engine idle speed (approximately 900 r/min). Delete the diagnosis record using the YDIS after checking the oil pressure.
- The actual oil pressure may vary depending on the temperature and viscosity of the engine oil being used.

Oil pressure (reference data):
600 kPa (6.0 kgf/cm^2, 87.0 psi) at 600–900 r/min

Checking the oil pressure sensor

1. Connect the test harness (3 pins) ① to the oil pressure sensor.

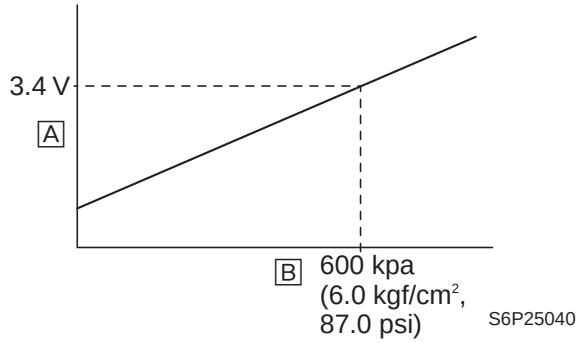


2. Start the engine and warm it up for 5 minutes.

3. Measure the oil pressure sensor input voltage. Check the wiring harness connection or replace the ECM if out of specification.

5

4. Measure the oil pressure sensor output voltage. Replace if out of specification.

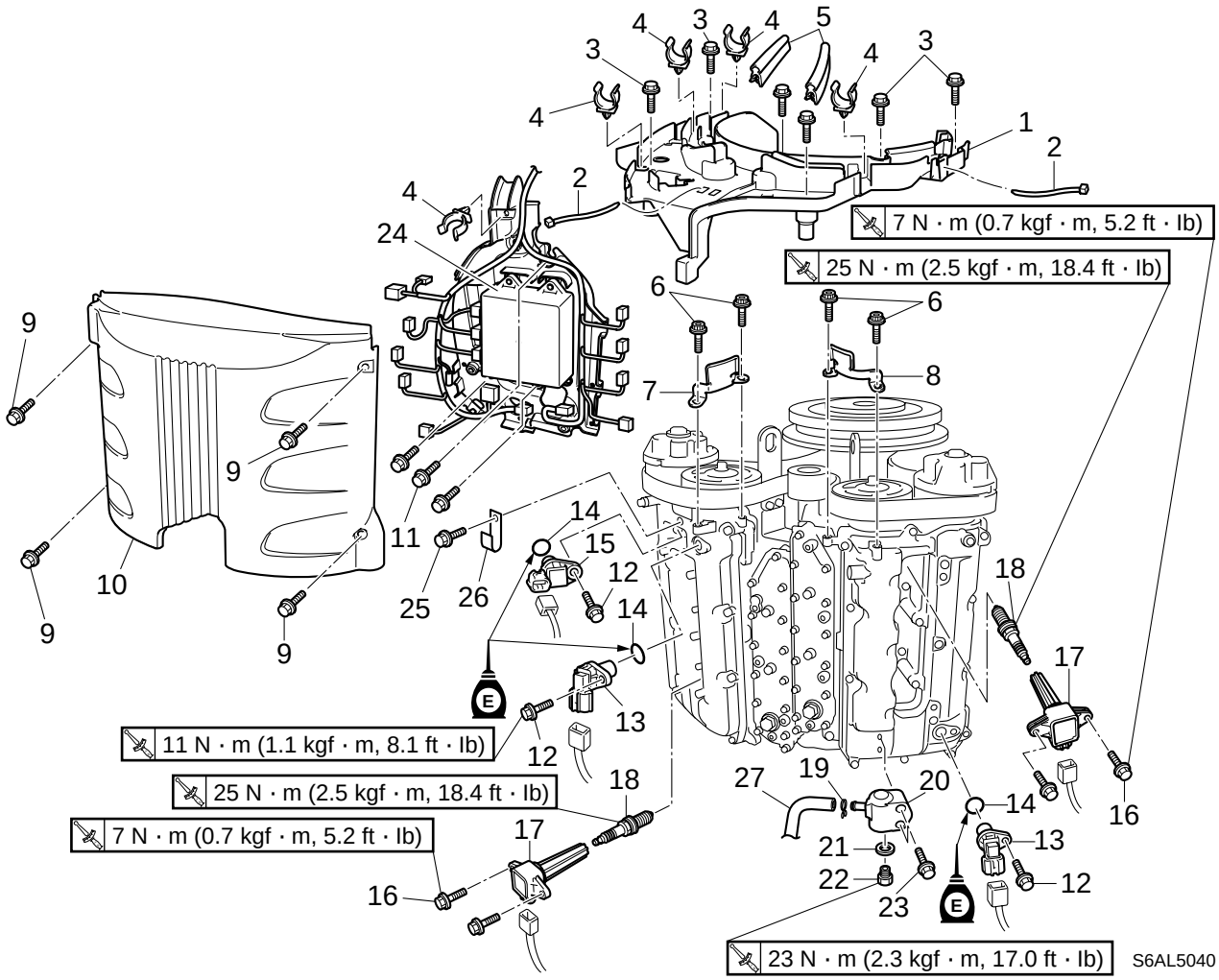


A Output voltage
B Oil pressure

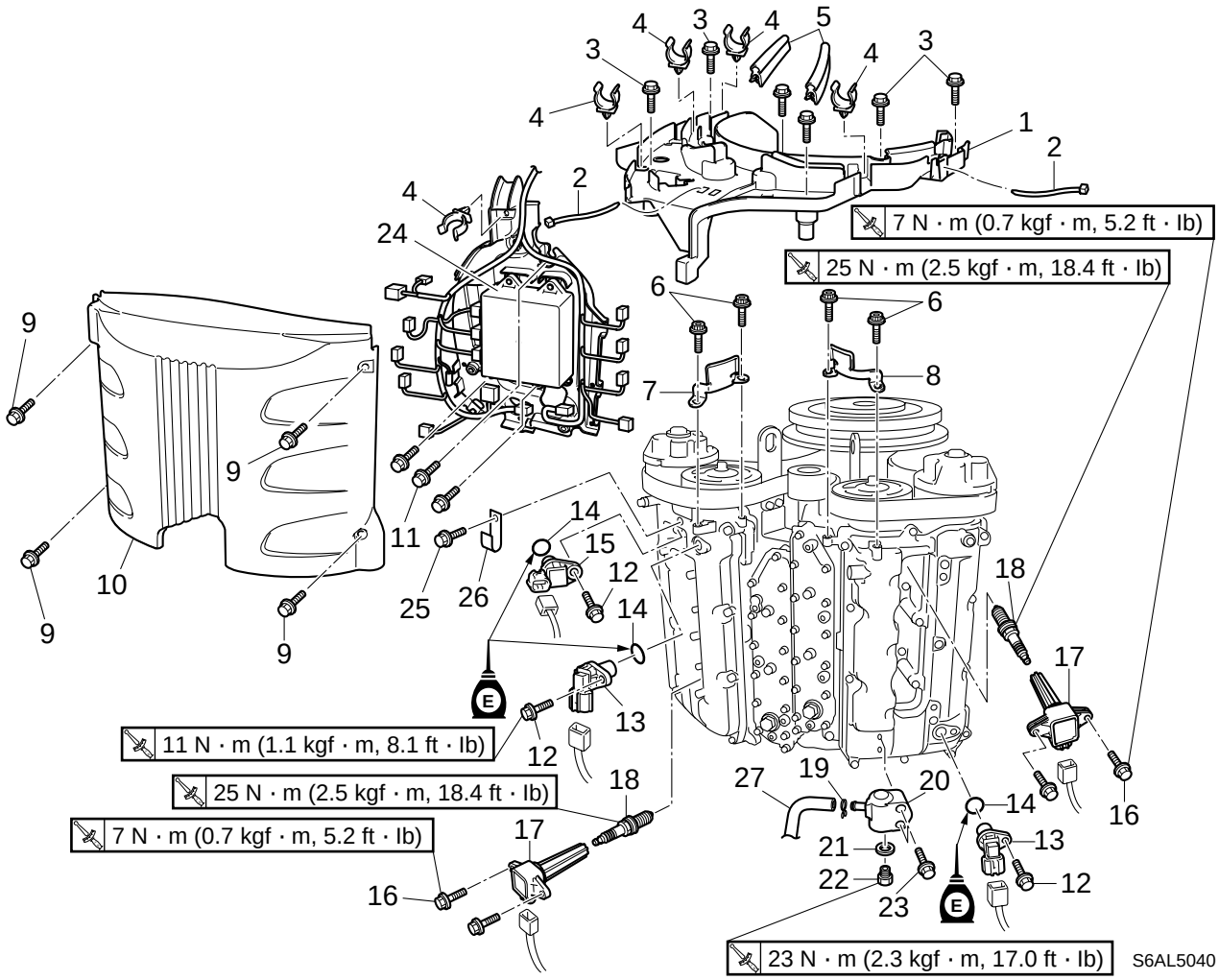
Test harness (3 pins) ①:
90890-06869

Oil pressure sensor input voltage (reference data):
Orange (O) – Black (B)
4.75–5.25 V
Oil pressure sensor output voltage (reference data):
Pink/white (P/W) – Black (B)
3.4 V at engine idle speed

ECM base assembly

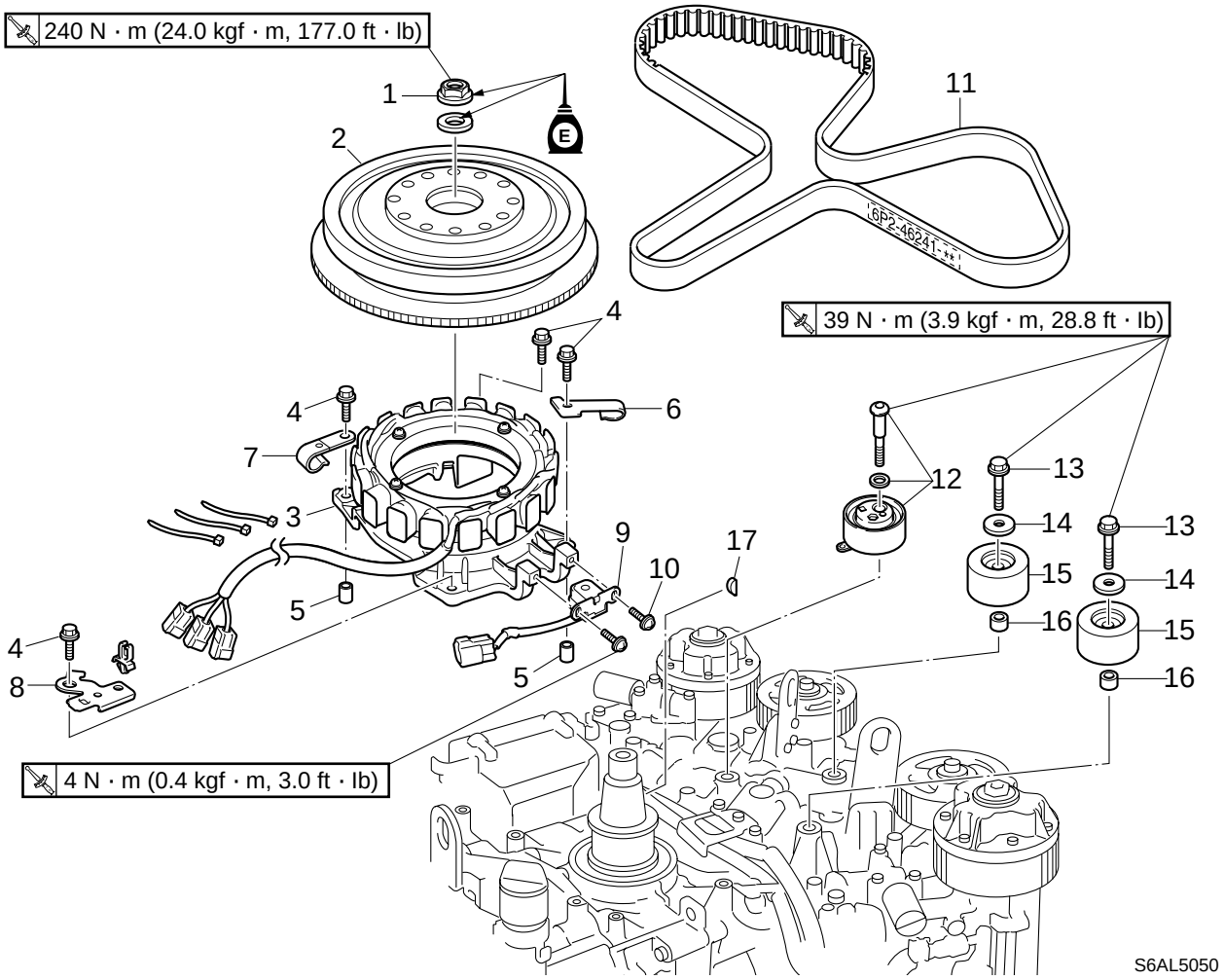


No.	Part name	Q'ty	Remarks
1	Wiring harness guide	1	
2	Plastic tie	2	
3	Bolt	6	M6 × 35 mm
4	Holder	5	
5	Damper	2	
6	Bolt	4	M6 × 14 mm
7	Timing belt guide (PORT)	1	
8	Timing belt guide (STBD)	1	
9	Bolt	4	M6 × 20 mm
10	ECM cover	1	
11	Bolt	4	M6 × 28 mm
12	Bolt	3	M6 × 20 mm
13	Cam position sensor (STBD IN, PORT EX)	2	
14	O-ring	3	**Not reusable**
15	Cam position sensor (PORT IN)	1	
16	Bolt	12	M6 × 20 mm
17	Ignition coil	6	



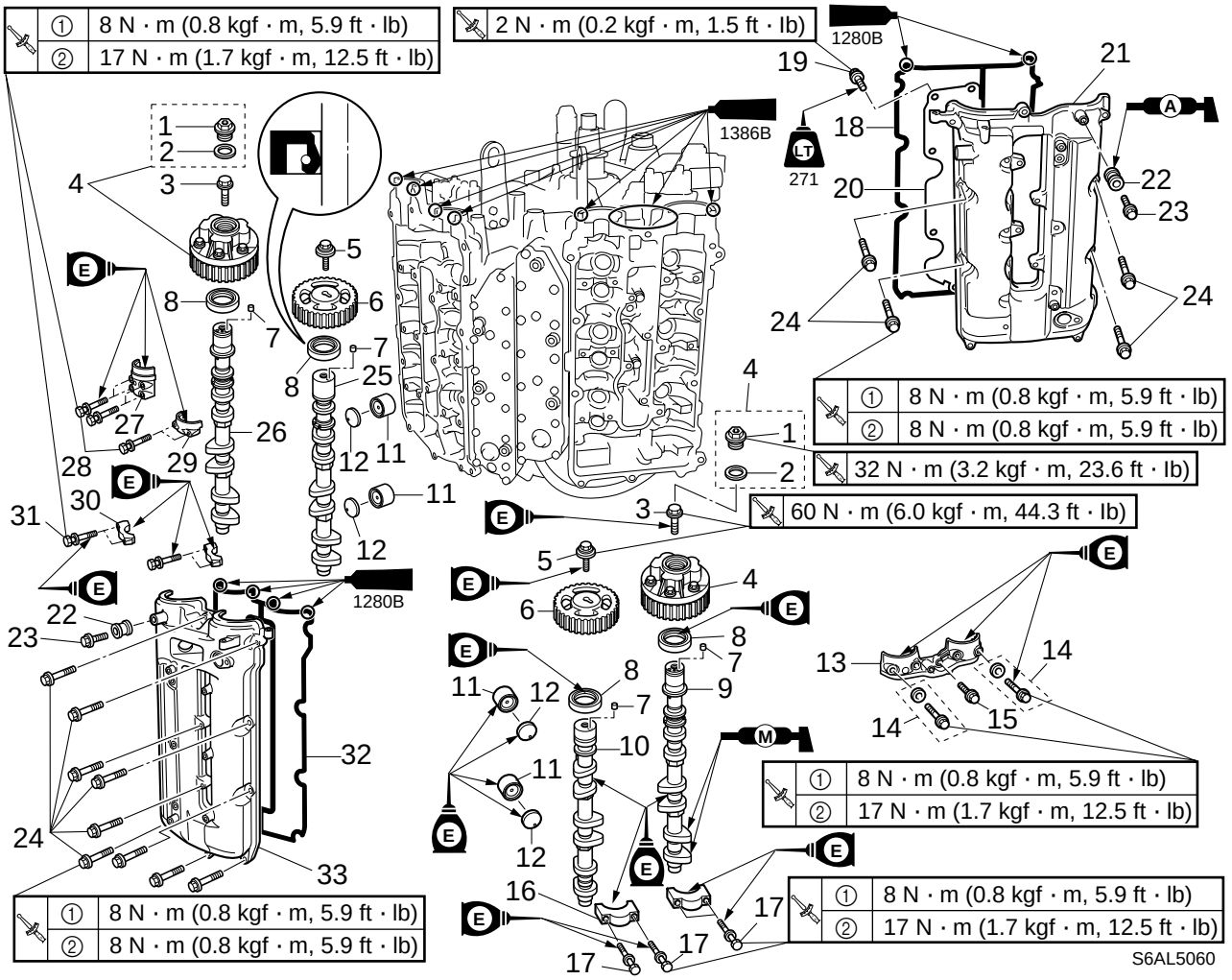
No.	Part name	Q'ty	Remarks
18	Spark plug	6	
19	Clamp	1	
20	Cooling water pressure sensor adapter	1	
21	Gasket	1	**Not reusable**
22	Plug	1	M14 × 12 mm
23	Bolt	2	M6 × 30 mm
24	ECM base assembly	1	
25	Bolt	1	M6 × 12 mm
26	Holder	1	
27	Hose	1	

Stator assembly

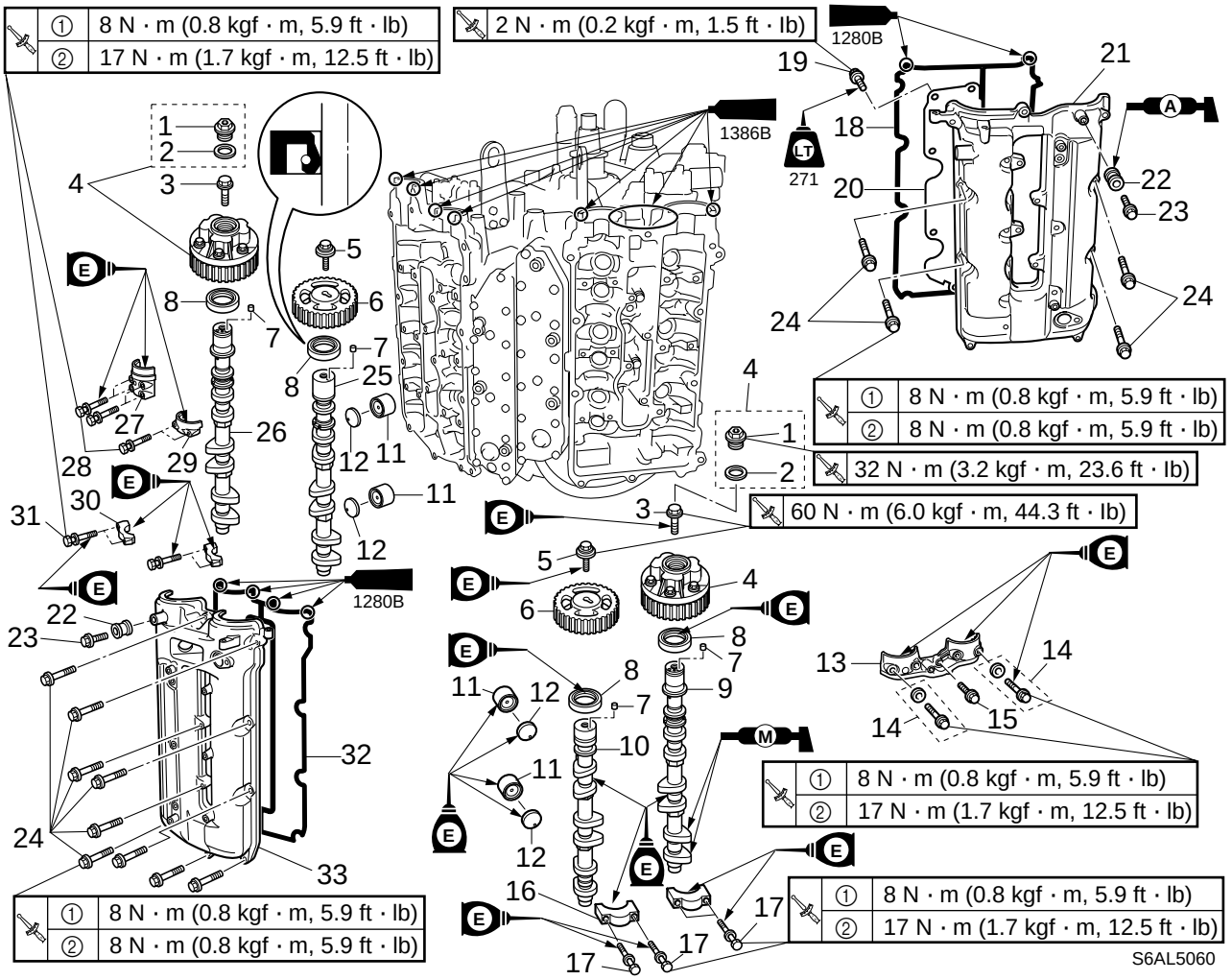


No.	Part name	Q'ty	Remarks
1	Nut	1	Width across flats: 36 mm
2	Flywheel magnet	1	
3	Stator assembly	1	
4	Bolt	4	M6 × 35 mm
5	Collar	2	
6	Holder	1	
7	Holder	1	
8	Bracket	1	
9	Crank position sensor	1	
10	Screw	2	ø5 × 12 mm
11	Timing belt	1	
12	Timing belt tensioner	1	
13	Bolt	2	M10 × 55 mm
14	Washer	2	
15	Pulley	2	
16	Collar	2	
17	Woodruff key	1	

Camshaft



No.	Part name	Q'ty	Remarks
1	Cap	2	
2	Gasket	2	**Not reusable**
3	Union bolt	2	M12 × 35 mm
4	Variable camshaft timing assembly	2	
5	Bolt	2	M10 × 35 mm
6	Driven sprocket	2	
7	Dowel	4	
8	Oil seal	4	**Not reusable**
9	Camshaft (STBD IN)	1	
10	Camshaft (STBD EX)	1	
11	Valve lifter	24	
12	Valve shim	24	
13	Camshaft cap	1	
14	Bolt with seal washer	4	M7 × 48 mm
			Not reusable
15	Bolt	1	M6 × 30 mm
16	Camshaft cap	7	
17	Bolt	14	M7 × 37 mm



No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Screw	8	ø4 × 8 mm
20	Plate	1	
21	Cylinder head cover (STBD)	1	
22	Grommet	2	
23	Bolt	2	M6 × 19 mm
24	Bolt	28	M6 × 30 mm
25	Camshaft (PORT EX)	1	
26	Camshaft (PORT IN)	1	
27	Camshaft cap	1	
28	Bolt	6	M7 × 48 mm
29	Camshaft cap	1	
30	Camshaft cap	6	
31	Bolt	12	M7 × 37 mm
32	Gasket	1	**Not reusable**
33	Cylinder head cover (PORT)	1	

Checking the valve clearance

CAUTION:

Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.

NOTE:

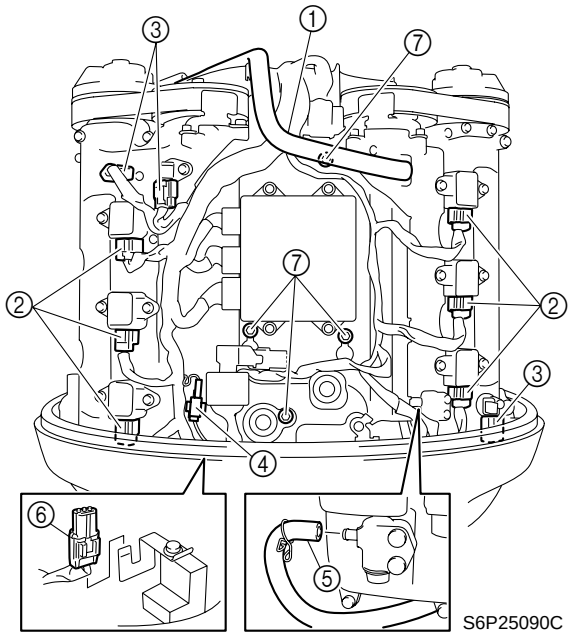
Measure the valve clearances when the engine is cold.

1. Reduce the fuel pressure.

NOTE:

When measuring or adjusting the valve clearances, the fuel line must be disconnected, so be sure to reduce the fuel pressure before performing the disassembly procedure. To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Remove the flywheel magnet cover and ECM cover.
3. Remove the blowby hose ①.
4. Disconnect the ignition coil couplers ②, cam position sensor couplers ③, knock sensor coupler ④, and cooling water pressure sensor adapter hose ⑤.
5. Remove the speed sensor coupler ⑥ from the bracket.
6. Remove all ignition coils and spark plugs.
7. Remove the ECM bracket bolts ⑦, then the ECM bracket.

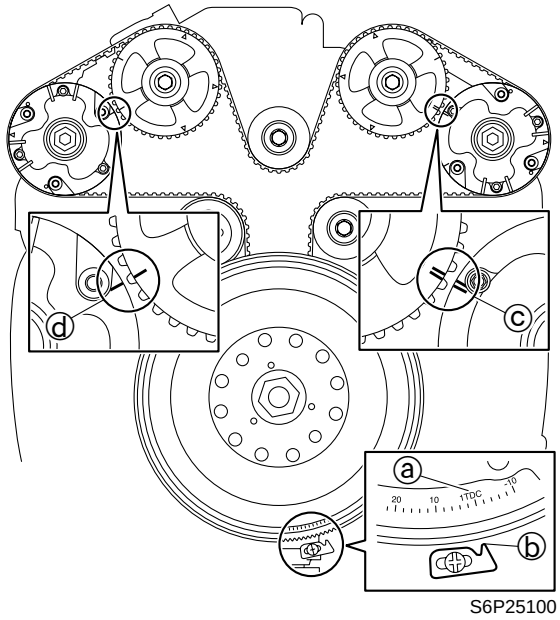


8. Remove the cylinder head covers (port and starboard).

NOTE:

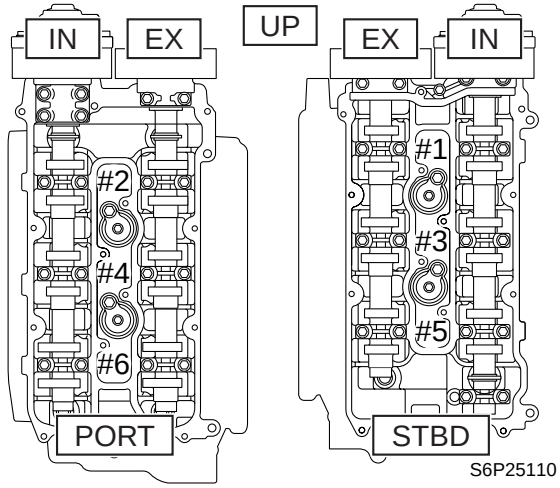
See the exploded diagram (5-7).

9. Turn the flywheel magnet clockwise and align the "1TDC" mark ⓐ on the flywheel magnet with the pointer ⓑ.
10. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.

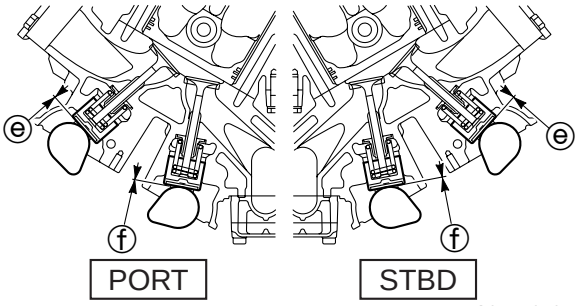


S6P25100

11. Measure each valve clearance ⓔ and ⓕ according to steps 12–17.



S6P25110



S6AL5070

NOTE:
Note the measurement data.

Valve clearance (cold):
Intake ⓔ:
0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust ⓕ:
0.34 ± 0.03 mm (0.013 ± 0.001 in)

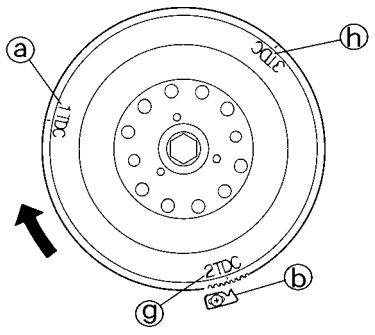
12. Measure the intake and exhaust valve clearances for cylinder #4.

13. Turn the flywheel magnet an additional 120° clockwise and align the “2TDC” mark ⓖ on the flywheel magnet with the pointer ⓑ.

14. Measure the intake and exhaust valve clearances for cylinder #5.

15. Turn the flywheel magnet an additional 120° clockwise and align the “3TDC” mark ⓗ on the flywheel magnet with the pointer ⓑ.

16. Measure the intake and exhaust valve clearances for cylinder #6.



S69J5120

17. Similarly, measure the valve clearances for cylinders #1, #2, and #3 in order, and be sure to turn the flywheel magnet 120° clockwise each time. Adjust the valve clearances if out of specification.

Adjusting the valve clearance

CAUTION:

Do not turn the flywheel magnet or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.

NOTE:

Check the valve clearances when the engine is cold.

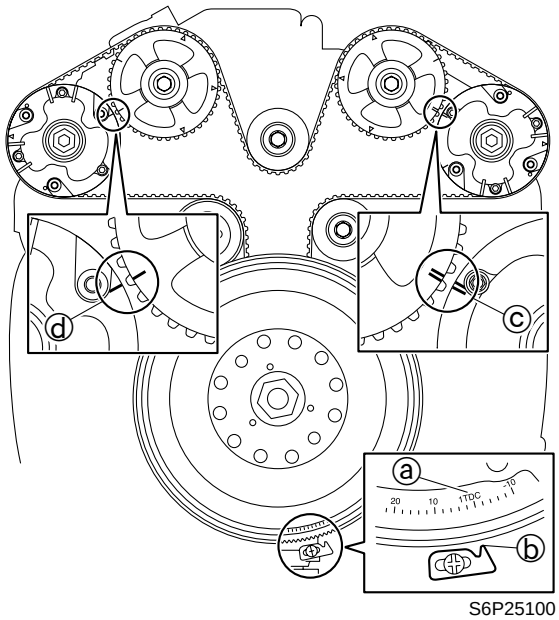
1. Reduce the fuel pressure.

NOTE:

To reduce the fuel pressure, see Chapter 4, “Reducing the fuel pressure.”

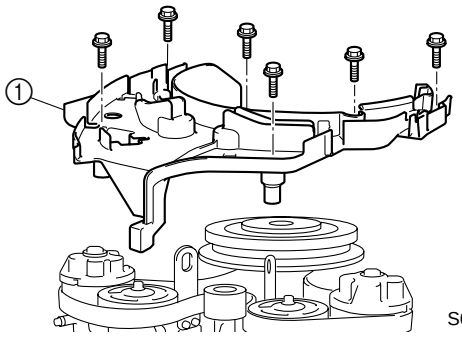
2. Turn the flywheel magnet clockwise and align the “1TDC” mark ⓐ on the flywheel magnet with the pointer ⓑ.

3. Check that the “II” marks ⓒ on the port driven sprockets are aligned, and check that the “I” marks ⓓ on the starboard driven sprockets are aligned.



S6P25100

4. Remove the wiring harness guide ①.

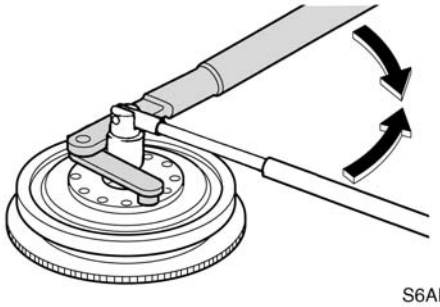


S6AL5150

NOTE:

To remove the wiring harness guide, see Chapter 5, “Removing the wiring harness.”

5. Loosen the flywheel magnet nut.


S6AL5A10

CAUTION:

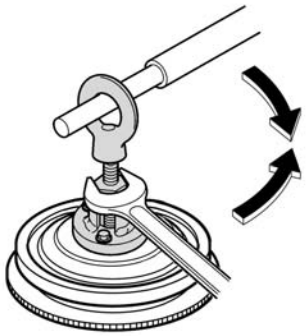
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

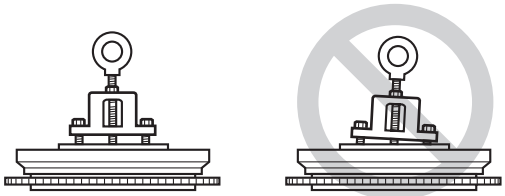
NOTE:

Use a 36 mm socket wrench to loosen the flywheel magnet nut.


Flywheel holder: 90890-06522

6. Remove the flywheel magnet and Woodruff key.


S6AL5A00


S6P25E00

CAUTION:

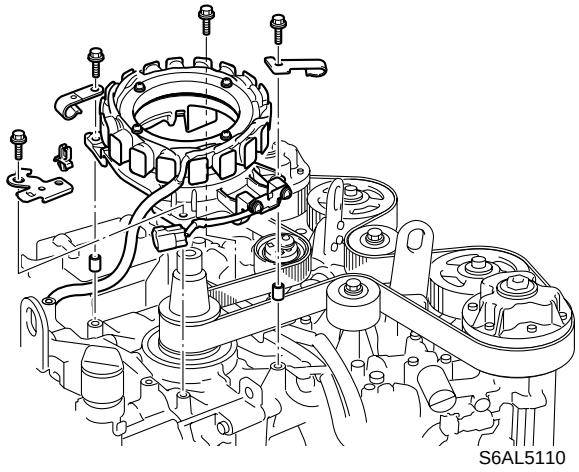
To prevent damage to the engine or tools, screw in the puller set bolts evenly and completely so that the flywheel puller is parallel to the flywheel magnet.

NOTE:

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

Flywheel puller: 90890-06521

7. Remove the stator assembly bolts, and then move the stator assembly.

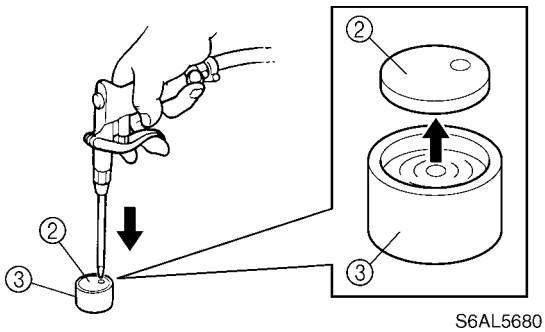

S6AL5110

8. Remove the timing belt, driven sprockets, and camshafts.

NOTE:

To remove the timing belt, driven sprockets, and camshafts, see Chapter 5, “Removing the timing belt, driven sprocket, and camshaft.”

9. Remove the valve shim ② from the valve lifter ③ using compressed air.



S6AL5680

NOTE:

Do not mix the valve train parts. Keep them organized in their proper groups.

10. Measure the valve shim thickness using a micrometer, and then note the measurement data.

11. Select the necessary valve shim by calculating its thickness using the following formula.

Necessary valve shim thickness = Removed valve shim thickness + Measured valve clearance – Specified valve clearance

Example:
If the "Removed valve shim thickness" is 2.10 mm, the "Measured valve clearance" is 0.30 mm and the "Specified valve clearance" is 0.20 mm, then the "Necessary valve shim thickness" = 2.10 + 0.30 – 0.20 = 2.20 mm.

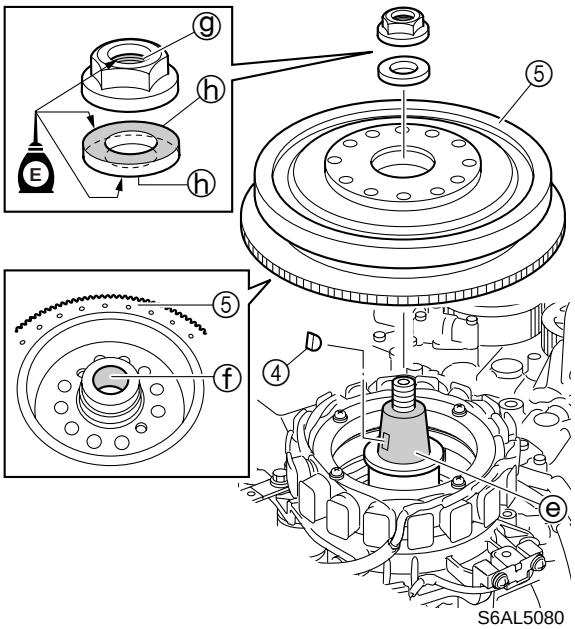
12. Install the necessary valve shim into the valve lifter.

13. Install the camshafts, driven sprockets, and timing belt.

NOTE:
To install the camshafts, driven sprockets, and timing belt, see Chapter 5, "Installing the camshaft, driven sprocket, and timing belt."

14. Install the stator assembly.

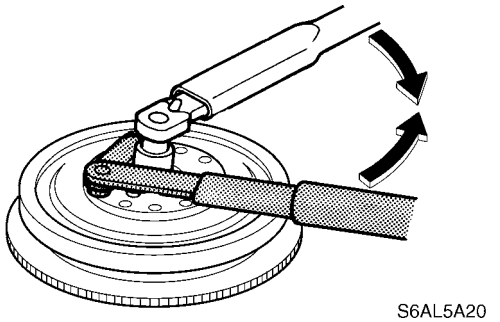
15. Install the Woodruff key ④, then the flywheel magnet ⑤.



S6AL5080

NOTE:
- Be sure to remove any grease from the tapered portion of the crankshaft ⓔ and the flywheel magnet ⓕ.
- Apply engine oil to the thread ⓖ of the flywheel magnet nut and upper and lower surface ⓗ of the washer before installation.

16. Tighten the flywheel magnet nut to the specified torque.


S6AL5A20

	Flywheel holder: 90890-06522

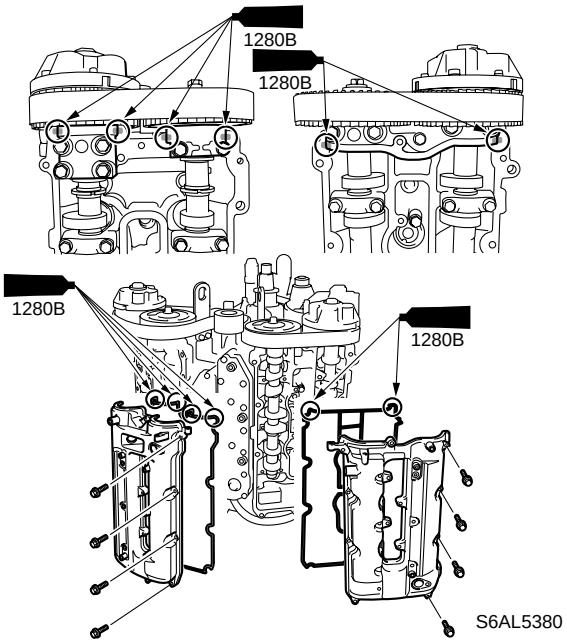
	Flywheel magnet nut: 240 N·m (24.0 kgf·m, 177.0 ft·lb)

17. Measure each valve clearance and adjust again if out of specification.

NOTE:
To checking the valve clearance, see Chapter 5, "Checking the valve clearance."

	Valve clearance (cold): Intake: 0.20 ± 0.03 mm (0.008 ± 0.001 in) Exhaust: 0.34 ± 0.03 mm (0.013 ± 0.001 in)

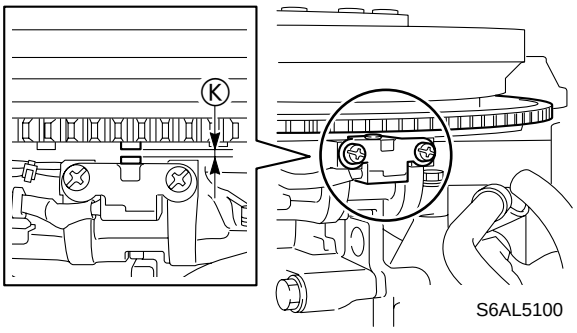
18. Install the cylinder head covers (port and starboard), and then tighten the bolts to the specified torque in 2 stages.



NOTE:
- Apply sealant to the edge of the cylinder head cover gasket before installation.
- Tighten the cylinder head cover bolts to the same torque in both stages.
- See the exploded diagram (5-7).

Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

19. Check the crank position sensor air gap ⓚ.

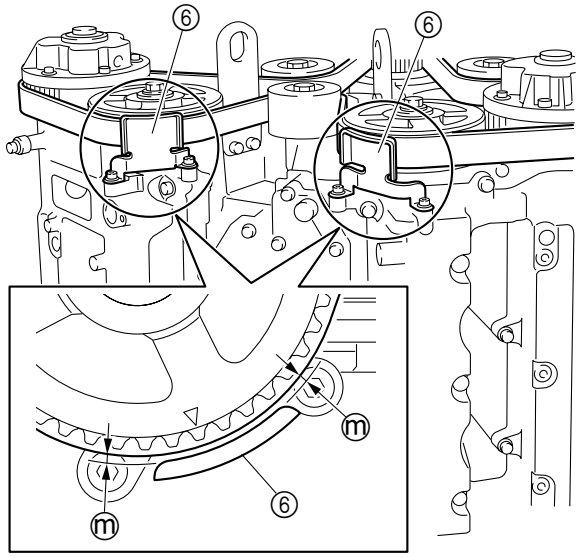


NOTE:
It is recommended to check the crank position sensor air gap before installing the wiring harness guide to improve working efficiency.

Crank position sensor air gap ⓚ:
1.4–1.6 mm (0.055–0.063 in)

Crank position sensor screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

20. Install the timing belt guides ⑥, and then adjust the timing belt-to-timing belt guide clearance ⓜ.



Timing belt-to-timing belt guide clearance ⓜ:
1.0 ± 0.5 mm (0.04 ± 0.02 in)

21. Install the wiring harness guide.

NOTE:
To install the wiring harness guide, see Chapter 5, “Installing the wiring harness.”

22. Install the spark plugs and ignition coils.

Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)
Ignition coil bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

23. Install all parts removed during disassembly.

5

24. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

Replacing the timing belt

CAUTION:

- **Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the flywheel magnet or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**

NOTE:

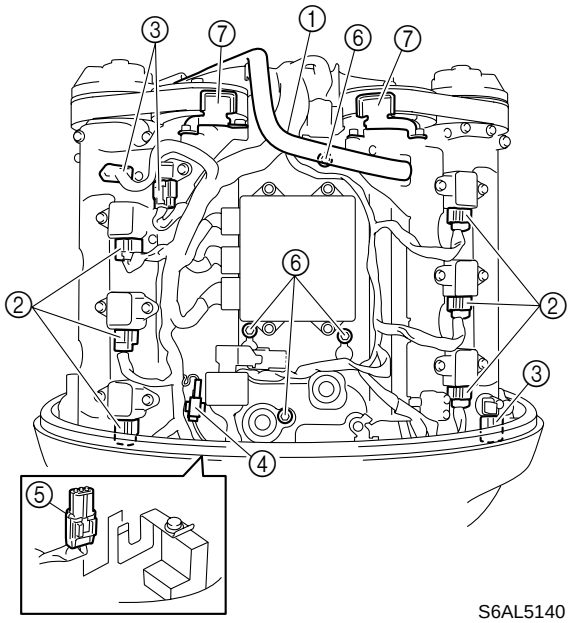
To remove and install the timing belt without replacing it, see Chapter 5, "Removing the timing belt, driven sprocket, and camshaft" and "Installing the camshaft, driven sprocket, and timing belt."

1. Reduce the fuel pressure.

NOTE:

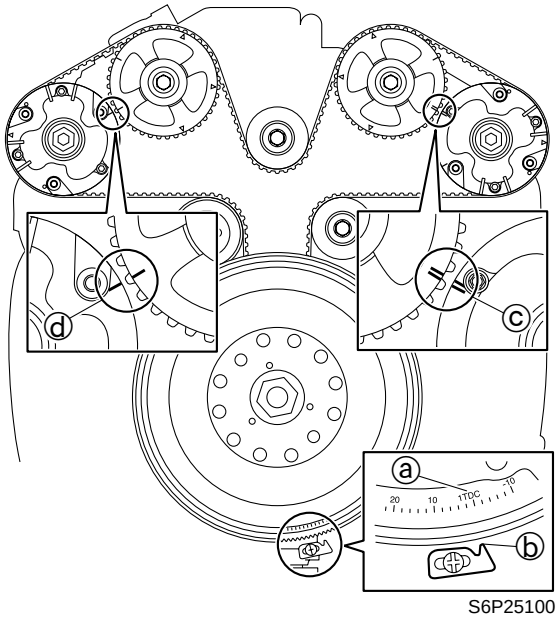
To reduce the fuel pressure, see Chapter 4, "Reducing the fuel pressure."

2. Remove the flywheel magnet cover and ECM cover.
3. Remove the blowby hose ①.
4. Disconnect the ignition coil couplers ②, cam position sensor couplers ③, and knock sensor coupler ④.
5. Remove the speed sensor coupler ⑤ from the bracket.
6. Remove all ignition coils and spark plugs.
7. Remove the ECM bracket bolts ⑥, then the ECM bracket.
8. Remove the timing belt guides ⑦.



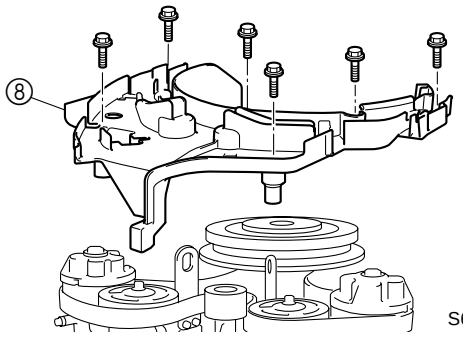
S6AL5140

9. Turn the flywheel magnet clockwise and align the "1TDC" mark ⓐ on the flywheel magnet with the pointer ⓑ.
10. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.



S6P25100

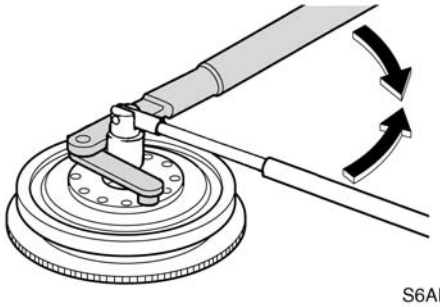
11. Remove the wiring harness guide ⑧.



S6AL5160

NOTE:
To remove the wiring harness guide, see Chapter 5, “Removing the wiring harness.”

12. Loosen the flywheel magnet nut.

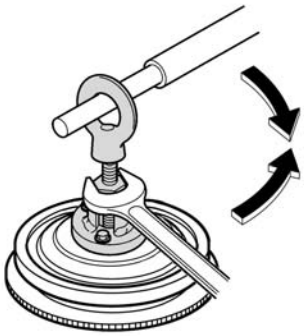

S6AL5A10

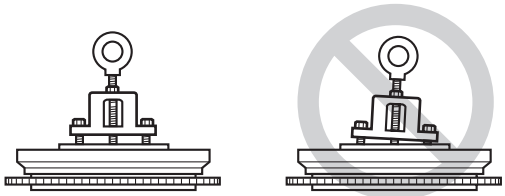
CAUTION:
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

NOTE:
Use a 36 mm socket wrench to loosen the flywheel magnet nut.

	Flywheel holder: 90890-06522

13. Remove the flywheel magnet and Woodruff key.


S6AL5A00


S6P25E00

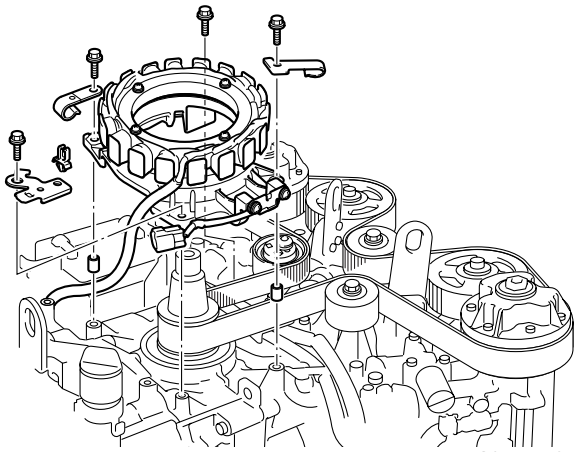
CAUTION:
To prevent damage to the engine or tools, screw in the puller set bolts evenly and completely so that the flywheel puller is parallel to the flywheel magnet.

NOTE:
Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

	Flywheel puller: 90890-06521

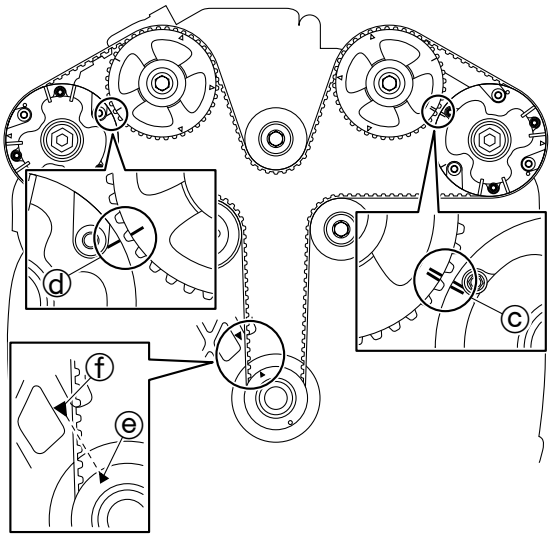
5

14. Remove the stator assembly bolts, and then move the stator assembly.


S6AL5110

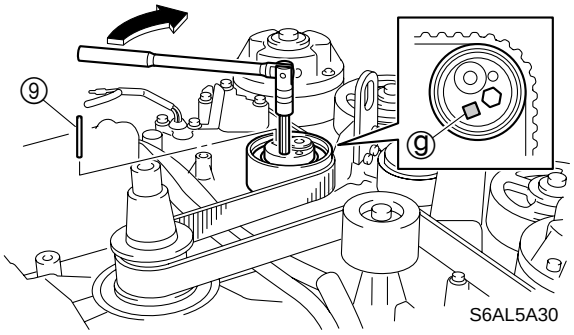
15. Check that the "▲" mark ⓔ on the drive sprocket and the "▲" mark ⓕ on the cylinder block are aligned.

16. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.



S6P25180

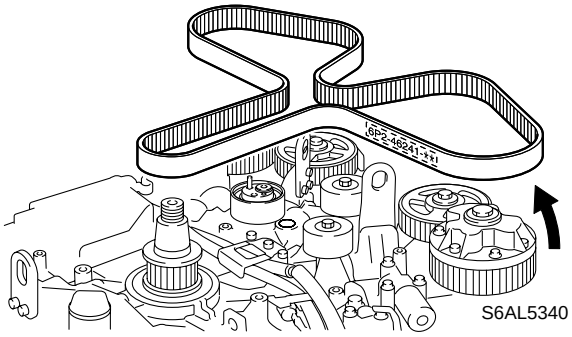
17. Turn the timing belt tensioner gradually clockwise using a hexagon wrench, and then insert a ø5.0 mm (0.2 in) pin ⑨ into the hole ⓖ.



S6AL5A30

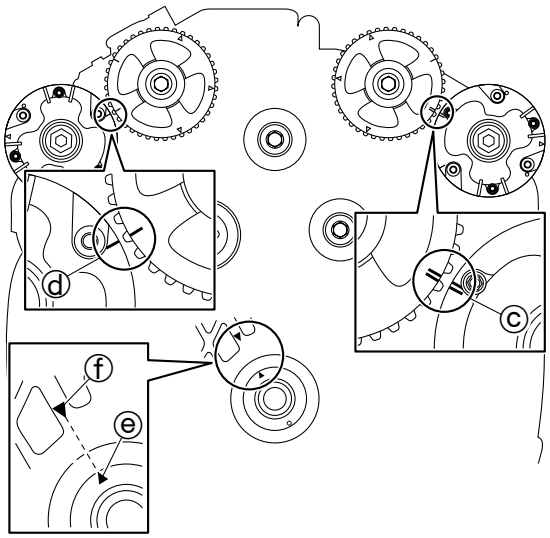
NOTE:
Leave the pin inserted into the hole ⓖ of the timing belt tensioner until the timing belt is installed again.

18. Remove the timing belt from the driven sprockets, then from the drive sprocket.


S6AL5340

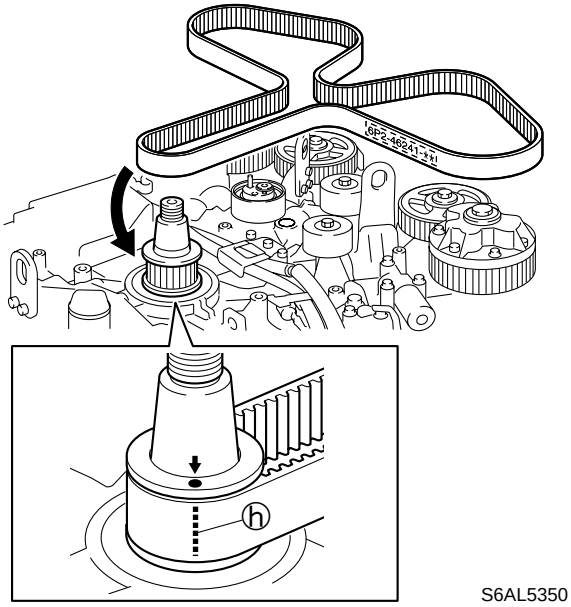
19. Check that the "▲" mark ⓔ on the drive sprocket and the "▲" mark ⓕ on the cylinder block are aligned.

20. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.

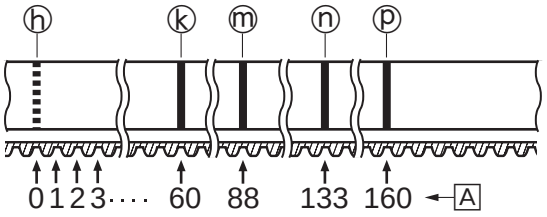


S6P25210

21. Install a new timing belt onto the drive sprocket with its part number in the upright position and align the belt position mark ⓗ with the "●" mark on the drive sprocket.



S6AL5350



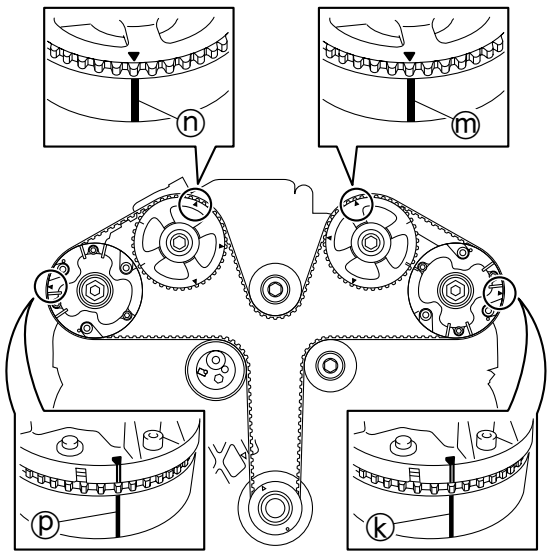
S6P25230

A Belt teeth number

CAUTION:

- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

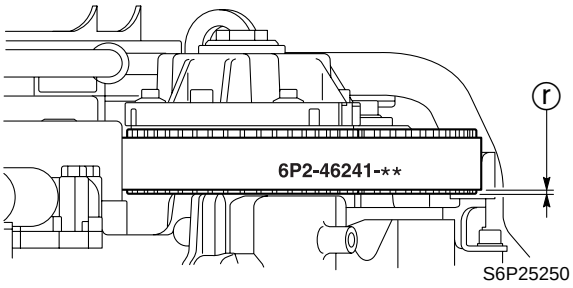
22. Install the timing belt onto the driven sprockets by aligning belt position marks ⓚ through Ⓟ with the "▲" marks on the driven sprockets.



S6P25240E

5

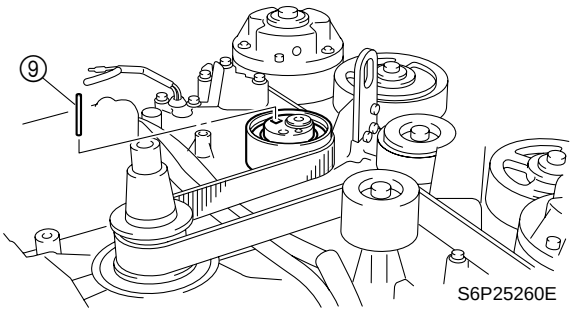
23. Adjust the timing belt to the specified installation height ⓡ.



S6P25250

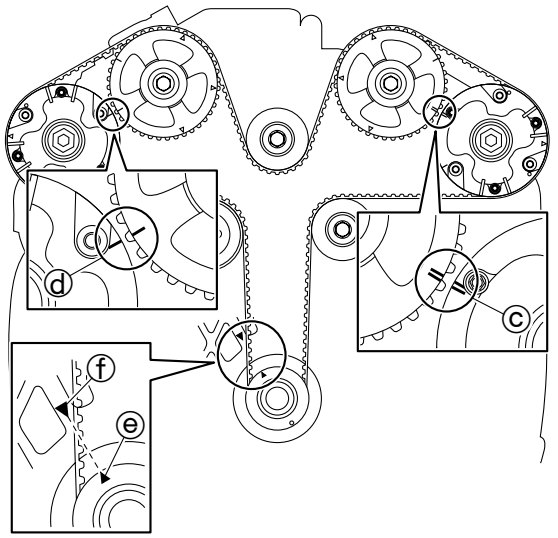
Timing belt installation height ⓡ:
2.0 mm (0.08 in)

24. Check that belt position marks ⓗ through ⓟ are aligned with each alignment mark on the drive sprocket and driven sprockets, and then remove the pin ⑨.



S6P25260E

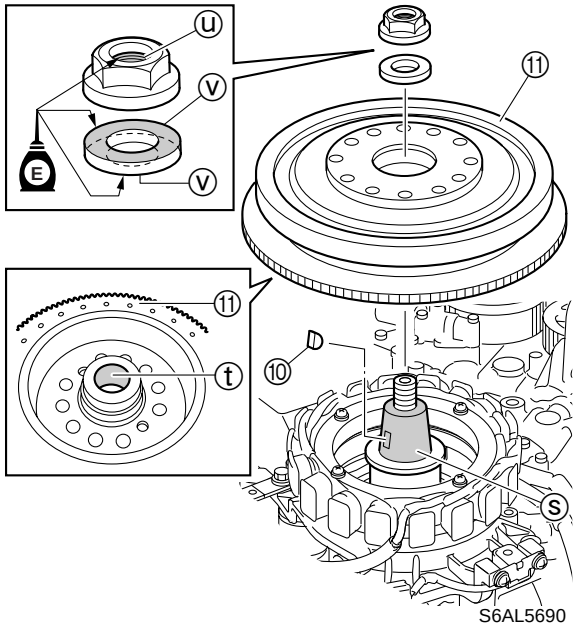
25. Turn the crankshaft clockwise 2 full turns, and then check that alignment marks ⓒ through ⓕ are aligned.



S6P25180

26. Install the stator assembly.

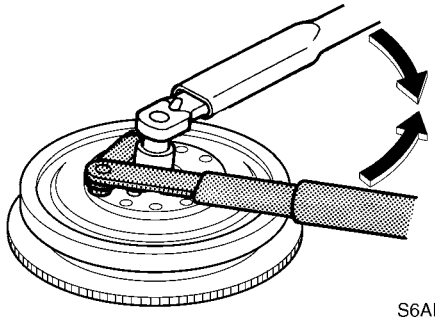
27. Install the Woodruff key ⑩, then the flywheel magnet ⑪.



S6AL5690

NOTE:
- Be sure to remove any grease from the tapered portion of the crankshaft ⓢ and flywheel magnet ⓣ.
- Apply engine oil to the thread ⓤ of the flywheel magnet nut and washer ⓥ before installation.

28. Tighten the flywheel magnet nut to the specified torque.

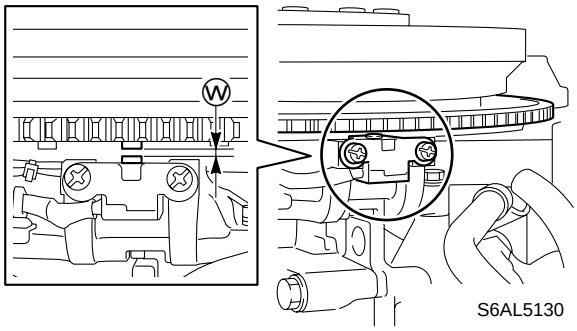


S6AL5A20

Flywheel holder: 90890-06522

Flywheel magnet nut:
240 N·m (24.0 kgf·m, 177.0 ft·lb)

29. Check the crank position sensor air gap Ⓦ.



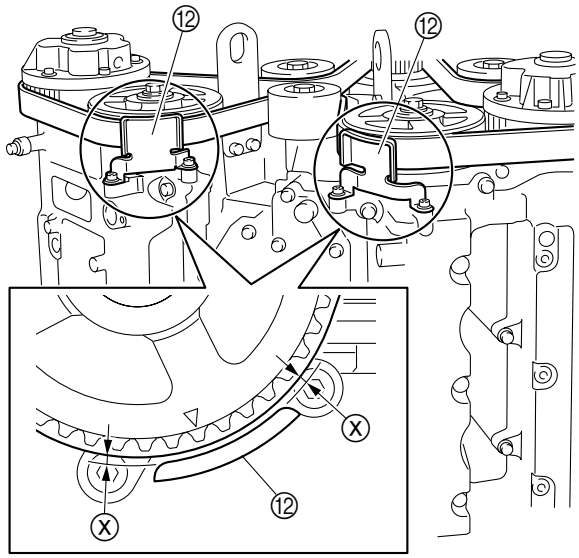
S6AL5130

NOTE:
It is recommended to check the crank position sensor air gap before installing the wiring harness guide to improve working efficiency.

Crank position sensor air gap Ⓦ:
1.4–1.6 mm (0.055–0.063 in)

Crank position sensor screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

30. Install the timing belt guides ⑫, and then adjust the timing belt-to-timing belt guide clearance Ⓧ.



S6AL5120

Timing belt-to-timing belt guide clearance Ⓧ:
1.0 ± 0.5 mm (0.04 ± 0.02 in)

31. Install the wiring harness guide.

NOTE:
To install the wiring harness guide, see Chapter 5, “Installing the wiring harness.”

32. Install all parts removed during disassembly.

33. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

5

Removing the timing belt, driven sprocket, and camshaft

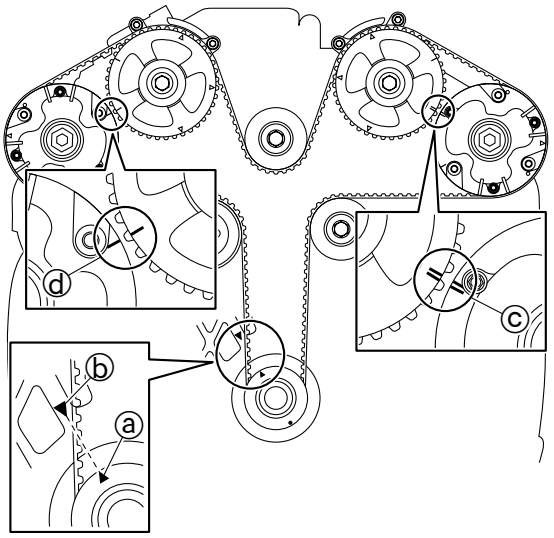
CAUTION:

- **Do not turn the crankshaft counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the crankshaft or the driven sprockets when the timing belt is not installed. Otherwise the piston and valves or intake and exhaust valves will collide with each other and be damaged.**
- **Do not turn the crankshaft and camshafts unless instructions have been given.**

NOTE:
Check the valve clearances before removing the parts.

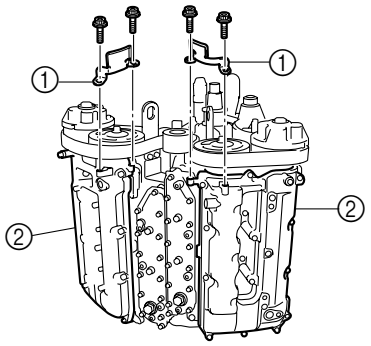
1. Check that the "▲" mark ⓐ on the drive sprocket and the "▲" mark ⓑ on the cylinder block are aligned.

2. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.



S6P25430

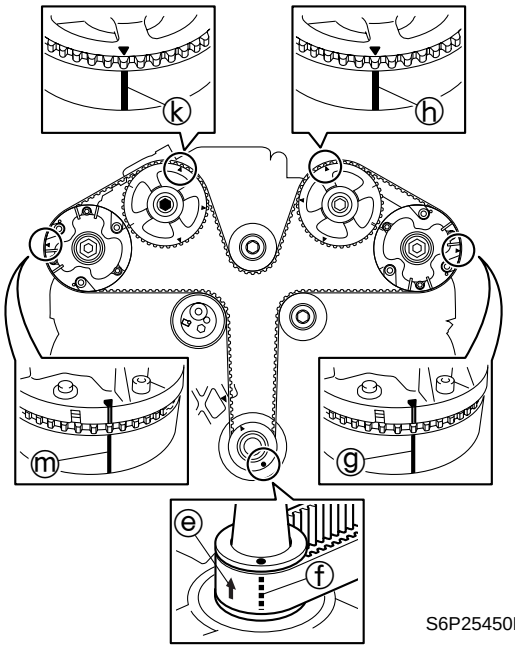
3. Remove the timing belt guides ① and cylinder head covers ②.



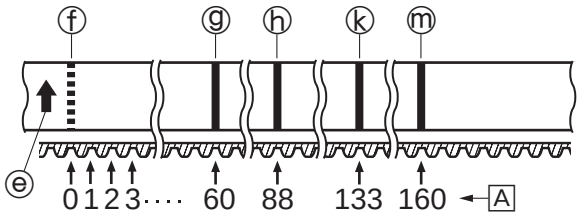
S6AL5720

NOTE:
See the exploded diagram (5-7).

4. Make marks ⓔ through ⓜ on the timing belt as shown.



S6P25450E

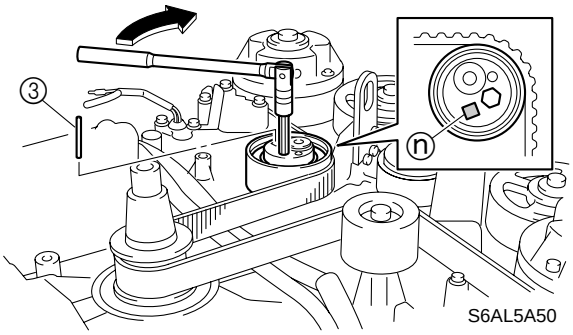


S6P25460

A Belt teeth number

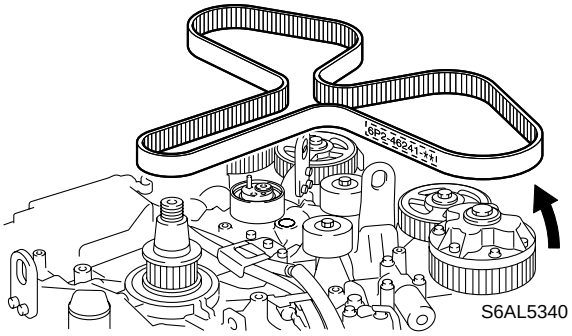
NOTE:
It is not necessary to mark the timing belt when replacing it.

5. Turn the timing belt tensioner gradually clockwise using a hexagon wrench, and then insert a ø5.0 mm (0.2 in) pin ③ into the hole ⓝ.

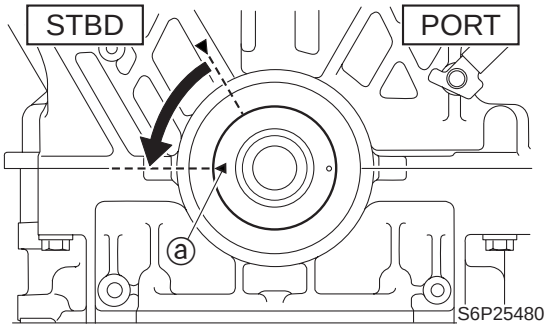


NOTE:
Leave the pin inserted into the hole ⓝ of the timing belt tensioner until the timing belt is installed again.

6. Remove the timing belt from the driven sprockets, then from the drive sprocket.

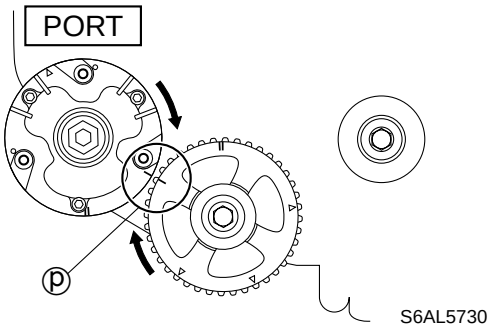


7. Align the "▲" mark ⓐ on the drive sprocket with the mating surface of the crankcase and cylinder block by turning the crankshaft counterclockwise 60° gradually.



CAUTION:
Do not turn the crankshaft counterclockwise more than 60°. Otherwise the piston and valves will collide with each other and be damaged.

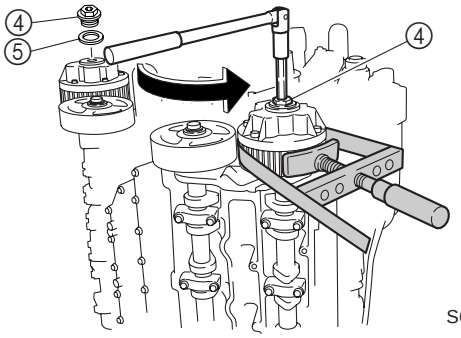
8. Align the "I" marks ⓟ on the port driven sprockets by turning them clockwise 60° gradually.



CAUTION:
- **Do not turn the port driven sprockets clockwise more than 60°, and do not turn the starboard driven sprockets. Otherwise the intake and exhaust valves will collide with each other and be damaged.**
- **Be careful when turning the driven sprockets. Depending on the position of the camshafts, the force of the valve springs may cause the driven sprockets to be rotated too far.**

5

9. Hold the intake driven sprocket using the special service tool, and then remove the variable camshaft timing cap ④.



S6P25500

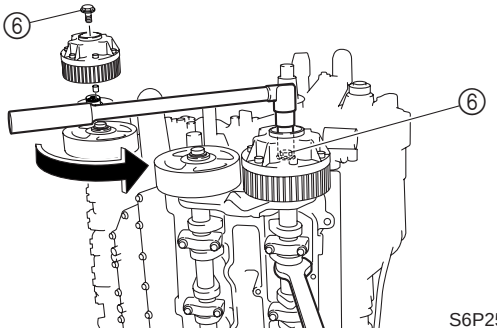
CAUTION:

- **Do not hold the camshaft when removing the variable camshaft timing cap. Otherwise the variable camshaft timing assembly can be damaged.**
- **Do not turn the driven sprocket when removing the variable camshaft timing cap. Otherwise the intake and exhaust valves will collide with each other and be damaged.**
- **Do not reuse the gasket ⑤, always replace it with a new one.**

Sheave holder: 90890-01701

10. Hold the intake camshaft using a wrench, and then remove the variable camshaft timing bolt ⑥.

11. Remove the variable camshaft timing assembly with the driven sprocket.



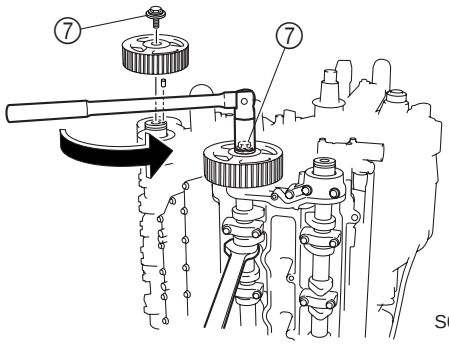
S6P25510

CAUTION:

- **Do not hold the driven sprocket when removing the variable camshaft timing bolt. Otherwise the variable camshaft timing assembly can be damaged.**
- **Do not turn the intake camshaft when removing the variable camshaft timing bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

12. Hold the exhaust camshaft using a wrench, and then remove the bolt ⑦.

13. Remove the exhaust driven sprocket.



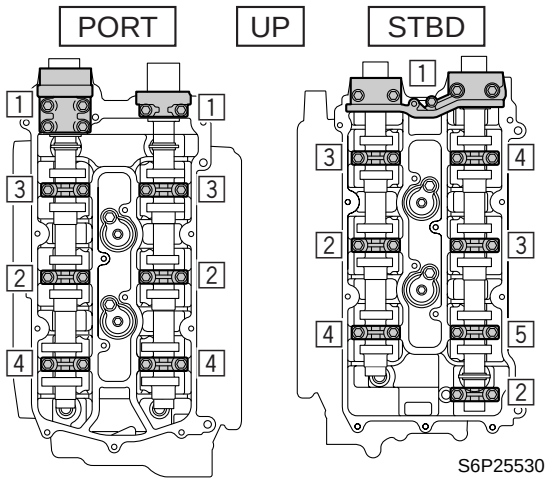
S6P25520

CAUTION:

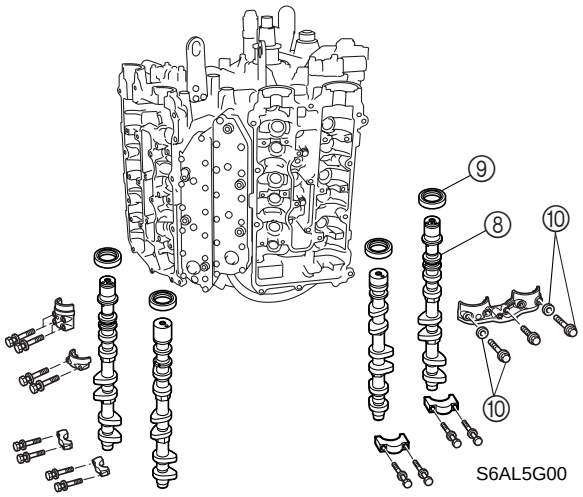
Do not turn the exhaust camshaft when removing the bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.

14. Remove the camshaft caps in the sequence shown.

15. Remove the camshafts ⑧ and oil seals ⑨.



S6P25530



S6AL5G00

CAUTION:

Do not reuse the bolts with seal washers ⑩, always replace them with new ones.

NOTE:

See the exploded diagram (5-7).

16. Remove the valve lifters from the cylinder heads.

NOTE:

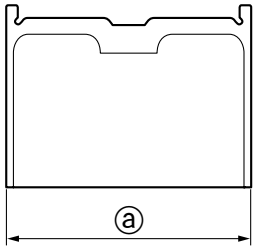
Do not mix the valve train parts. Keep them organized in their proper groups.

Checking the timing belt and sprocket

1. Check the interior and exterior of the timing belt. Replace if cracked, damaged, or worn.
2. Check the drive sprocket. Replace the crankshaft assembly if cracked, damaged, or worn.
3. Check the driven sprockets. Replace the variable camshaft timing assembly or driven sprocket if cracked, damaged, or worn.

Checking the valve lifter

1. Check the valve lifters. Replace if damaged, scratched, or worn.
2. Measure the valve lifter outside diameter. Replace if out of specification.



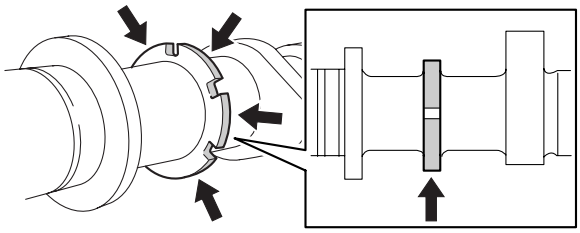
S6AL5B40

Valve lifter outside diameter ⓐ:
32.982–32.997 mm
(1.2985–1.2991 in)

5

Checking the camshaft

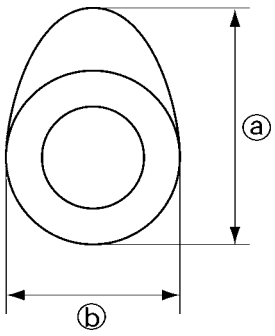
1. Check the edge and face of the brim on the port camshafts and starboard intake camshaft that is used for the cam position sensor. Replace if rough, damaged, or scratched.



S6AL5G50

NOTE:
- Do not scratch or damage the face of the brim.
- If there is a scratch more than 0.2 mm (0.008 in) deep or more than 0.5 mm (0.020 in) wide on the surface of the brim, a malfunction may occur in the cam position sensor signal.

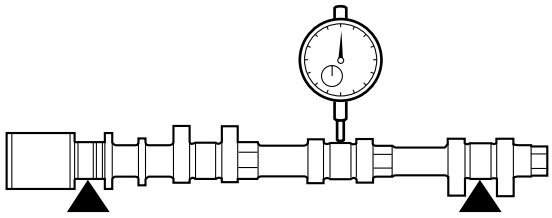
2. Measure the cam lobe. Replace if out of specification.



S69J5950

Cam lobe ⓐ:
Intake:
46.30–46.40 mm
(1.823–1.827 in)
Exhaust:
45.35–45.45 mm
(1.785–1.789 in)
Cam lobe ⓑ:
Intake and exhaust:
35.95–36.05 mm
(1.415–1.419 in)

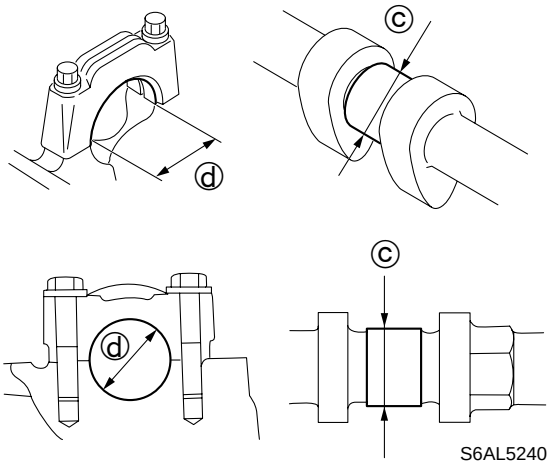
3. Measure the camshaft runout. Replace if above specification.



S6P25560

Camshaft runout limit:
0.015 mm (0.0006 in)

4. Measure the camshaft journal diameter ⓒ and cylinder head journal inside diameter ⓓ. Replace the camshaft or cylinder head assembly, or both if out of specifications.



S6AL5240

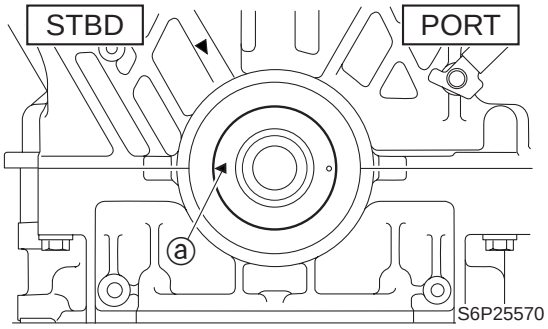
Camshaft journal diameter ⓒ:
24.96–24.98 mm
(0.9826–0.9834 in)
Camshaft cap inside diameter ⓓ:
25.000–25.021 mm
(0.9843–0.9851 in)

Installing the camshaft, driven sprocket, and timing belt

CAUTION:

- **Do not turn the crankshaft counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the crankshaft or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**
- **Do not turn the crankshaft and camshafts unless instructions have been given.**

1. Check that the "▲" mark ⓐ on the drive sprocket is aligned with the mating surface of the crankcase and cylinder block.

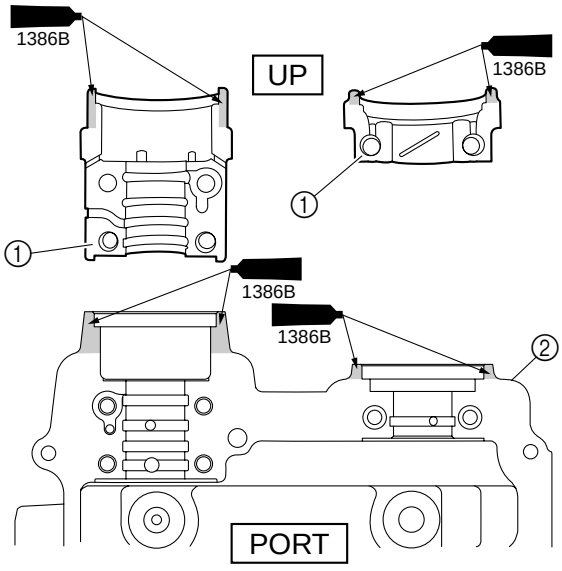


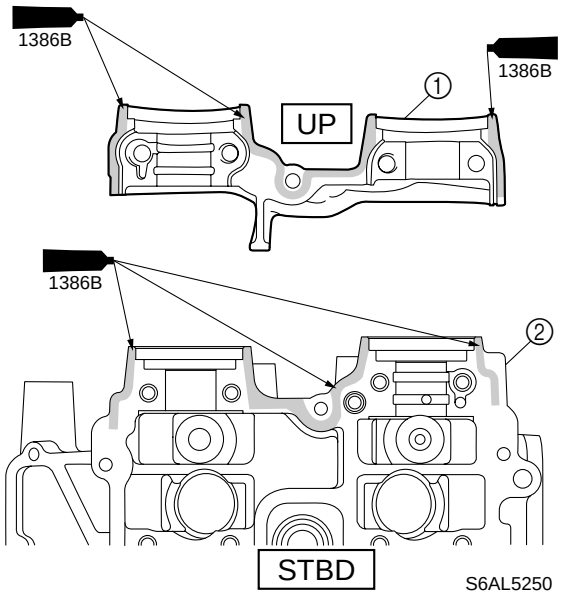
2. Install the valve lifters onto the cylinder heads.

NOTE:

- Apply engine oil to the valve shims and valve lifters before installation.
- Install the valve shims and valve lifters in their original positions.

3. Apply a thin, even coat of sealant to the mating surface of the camshaft caps ① cylinder heads ② as shown.



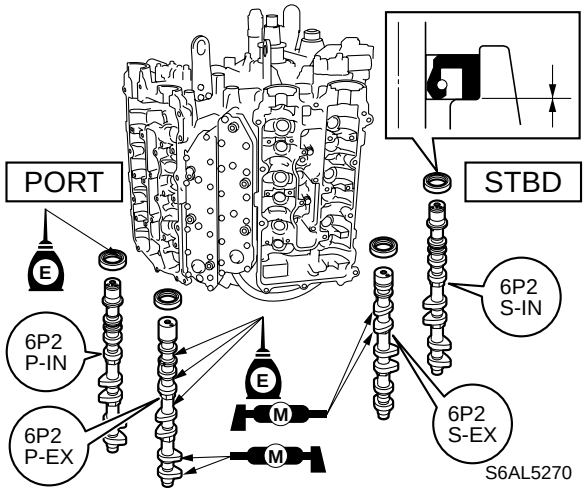


NOTE:

When applying the sealant, be sure not to block the oil passages or oil holes and do not apply it to the cylinder head journals.

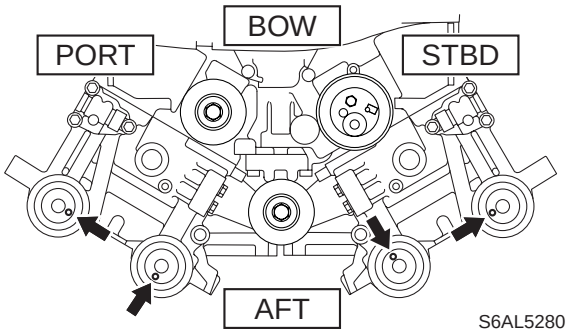
5

4. Install the camshafts with the oil seals.

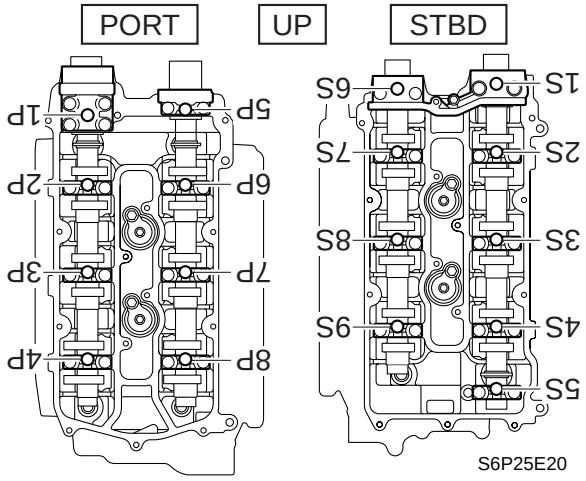


NOTE:
- Apply molybdenum disulfide grease to the cam lobes.
- Be sure to install the camshafts in the proper positions.
- See the exploded diagram (5-7).

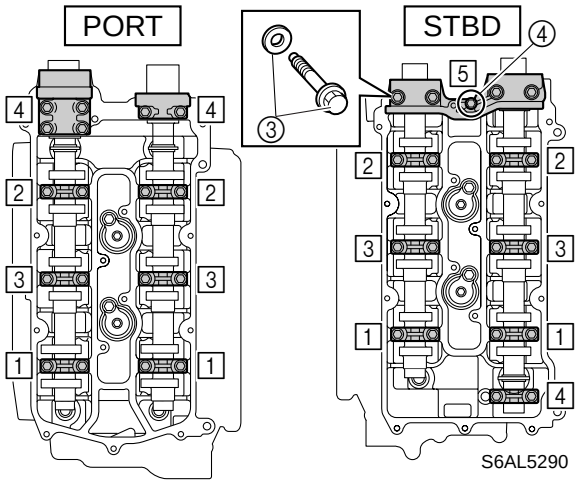
5. Check that the camshaft dowel holes are in the position shown in the illustration.



6. Install the camshaft caps in their proper positions as shown and with the stamped numbers upside down.



7. Tighten the camshaft cap bolts to the specified torques in 2 stages and in the sequence shown.



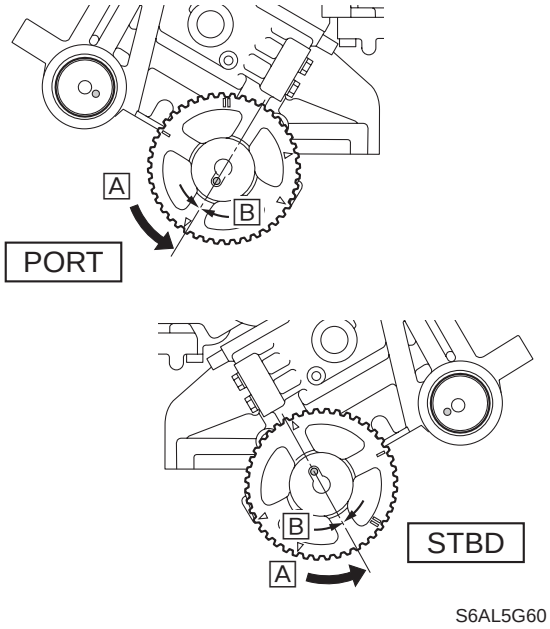
CAUTION:
Do not reuse the bolts with seal washers ③, always replace them with new ones.

NOTE:
- Apply engine oil to the camshaft caps and camshaft cap bolts before installation.
- Tighten the camshaft cap bolt ④ (M6 × 30 mm) to the general torque only. Do not tighten it to 17 N·m (1.7 kgf·m, 12.5 ft·lb).

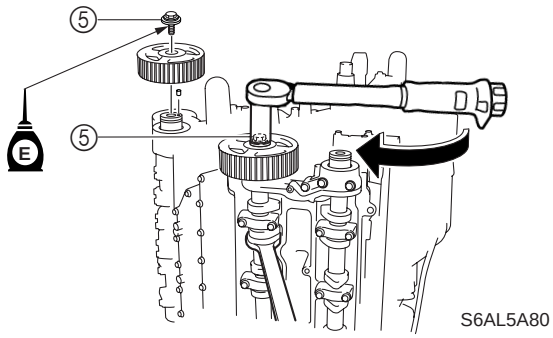
Camshaft cap bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

8. Install the dowel and exhaust driven sprocket on the exhaust camshaft.

9. Hold the exhaust camshaft using a wrench, and then tighten the driven sprocket bolt ⑤ to the specified torque.



S6AL5G60



S6AL5A80

CAUTION:

Do not turn the exhaust camshaft when tightening the bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.

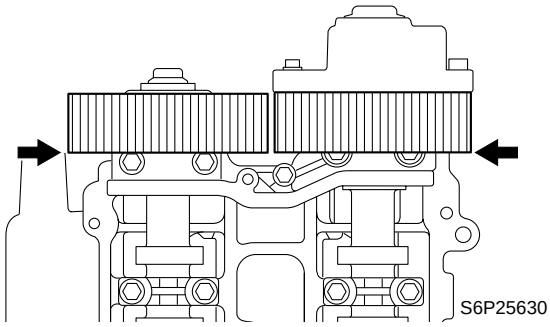
NOTE:

Slight turn the driven sprockets in direction A to remove any free play B before tightening the driven sprocket bolt ⑤.

	Driven sprocket bolt ⑤: 60 N·m (6.0 kgf·m, 44.3 ft·lb)

10. Install the dowel and variable camshaft timing assembly on the intake camshaft.

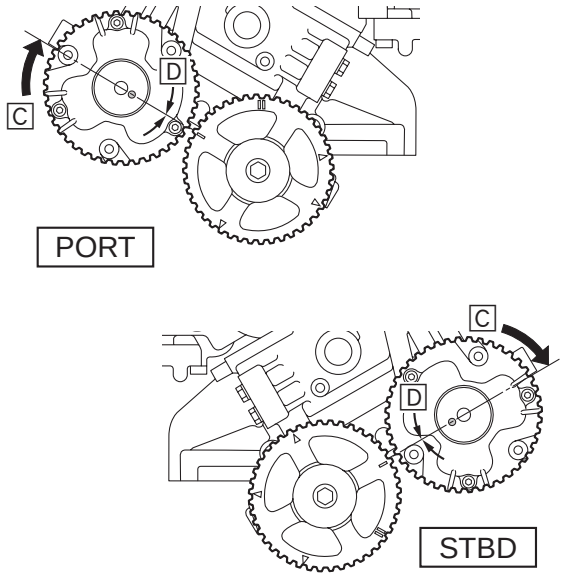
11. Check that the lower edge of the intake and exhaust driven sprockets are aligned.



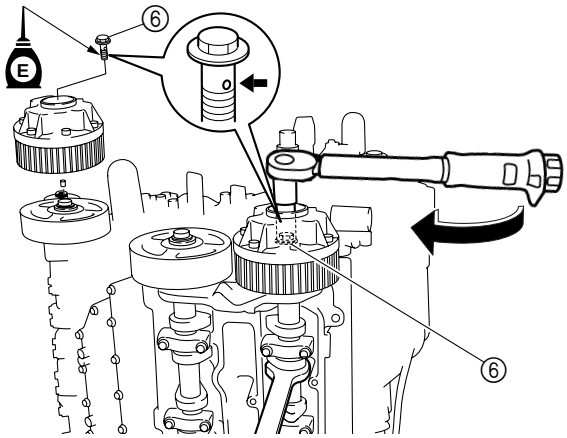
S6P25630

5

12. Hold the intake camshaft using a wrench, and then tighten the variable camshaft timing bolt ⑥ to the specified torque.



S6AL5G70



S6AL5A90

CAUTION:

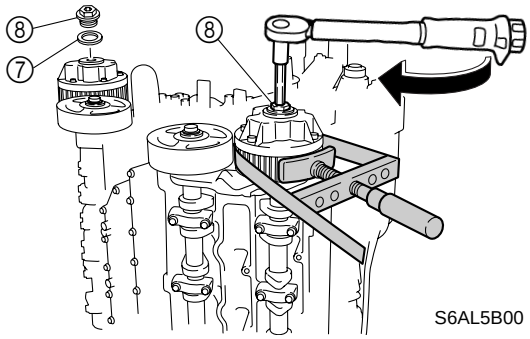
- **Do not hold the driven sprocket when tightening the variable camshaft timing bolt. Otherwise the variable camshaft timing assembly could be damaged.**
- **Do not turn the intake camshaft when tightening the variable camshaft timing bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

NOTE:

Slight turn the driven sprockets in direction C to remove any free play D before tightening the variable camshaft timing bolt ⑥.

Variable camshaft timing bolt ⑥:
60 N·m (6.0 kgf·m, 44.3 ft·lb)

13. Install a new gasket ⑦ and the variable camshaft timing cap ⑧, and then tighten the cap to the specified torque while holding the driven sprocket using the special service tool.



S6AL5B00

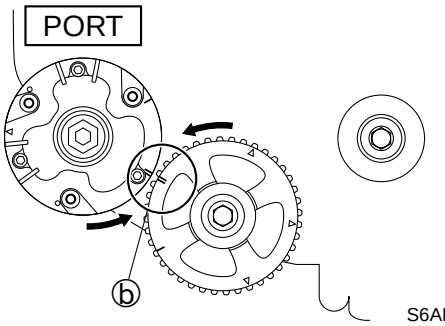
CAUTION:

- **Do not reuse the gaskets ⑦, always replace them with new ones.**
- **Do not hold the camshaft when tightening the variable camshaft timing cap. Otherwise the variable camshaft timing assembly could be damaged.**
- **Do not turn the driven sprocket when tightening the variable camshaft timing cap. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

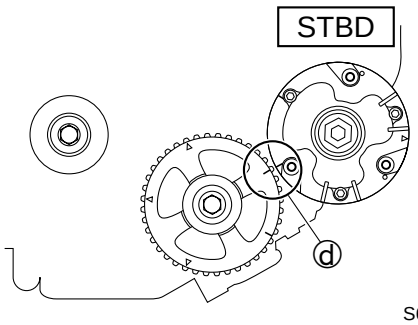
Sheave holder: 90890-01701

Variable camshaft timing cap ⑧:
32 N·m (3.2 kgf·m, 23.6 ft·lb)

14. Align the “II” marks ⓑ on the port driven sprockets by turning them counterclockwise 60° gradually.



S6AL5740

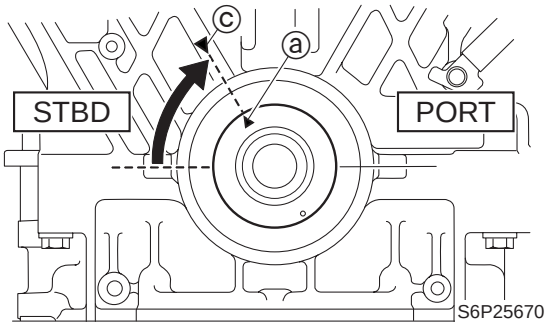


S6AL5750

CAUTION:

- **Do not turn the port driven sprockets counterclockwise more than 60°, and do not turn the starboard driven sprockets. Otherwise the intake and exhaust valves will collide with each other and be damaged.**
- **Be careful when turning the driven sprockets. Depending on the position of the camshafts, the force of the valve springs may cause the driven sprockets to be rotated too far.**

15. Align the "▲" mark ⓐ on the drive sprocket with the "▲" mark ⓒ on the cylinder block by turning the crankshaft clockwise 60° gradually.



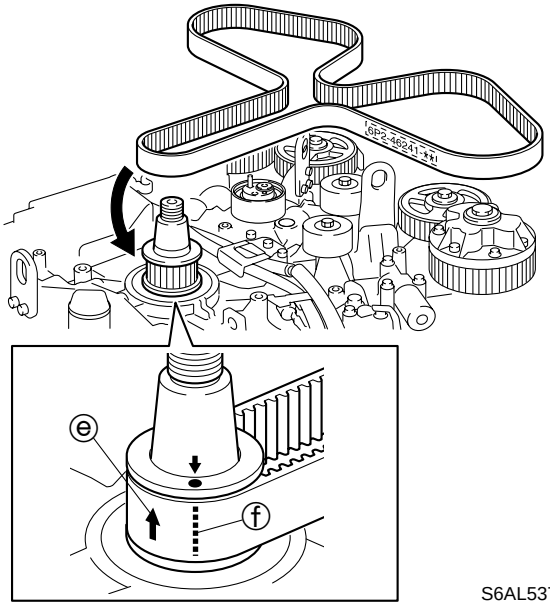
S6P25670

CAUTION:

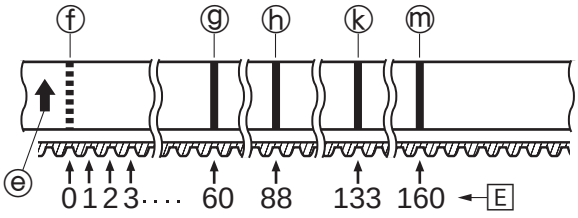
Do not turn the crankshaft clockwise more than 60°. Otherwise the piston and valves will collide with each other and be damaged.

16. Check that the "I" marks ⓓ on the starboard driven sprockets are aligned.

17. Install the timing belt onto the drive sprocket with the arrow mark ⓔ facing upward and align the timing belt mark ⓕ with the "●" mark on the drive sprocket.



S6AL5370



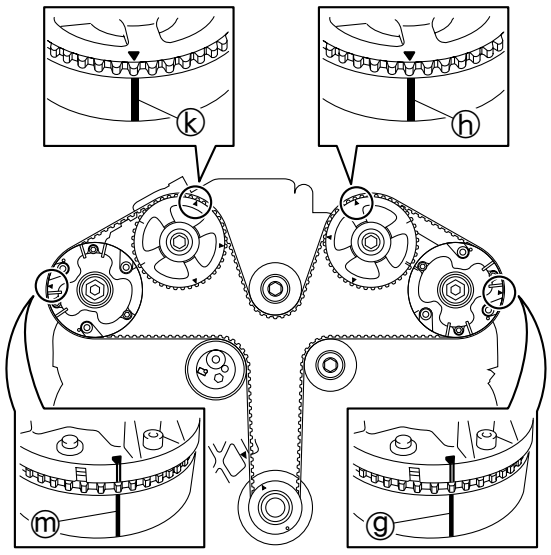
S6P25460E

E Belt teeth number

CAUTION:

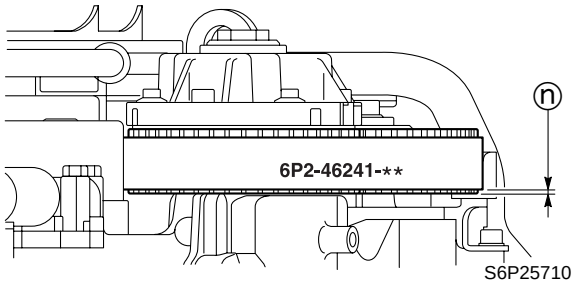
- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

18. Install the timing belt onto the driven sprockets by aligning belt position marks ⓖ through ⓜ with the "▲" marks on the driven sprockets.



S6P25700E

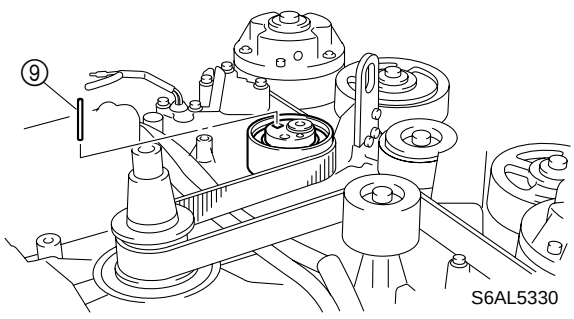
19. Adjust the timing belt to the specified installation height ⓝ.



S6P25710

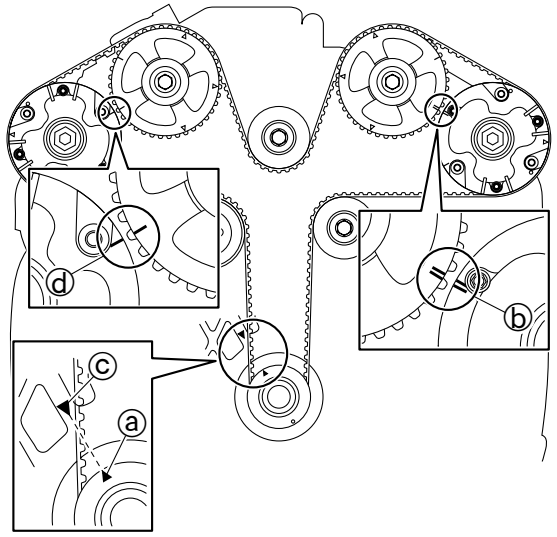
Timing belt installation height ⓝ:
2.0 mm (0.08 in)

20. Check that belt position marks ⓖ through ⓜ are aligned with each alignment mark on the drive sprocket and driven sprockets, and then remove the pin ⑨.



S6AL5330

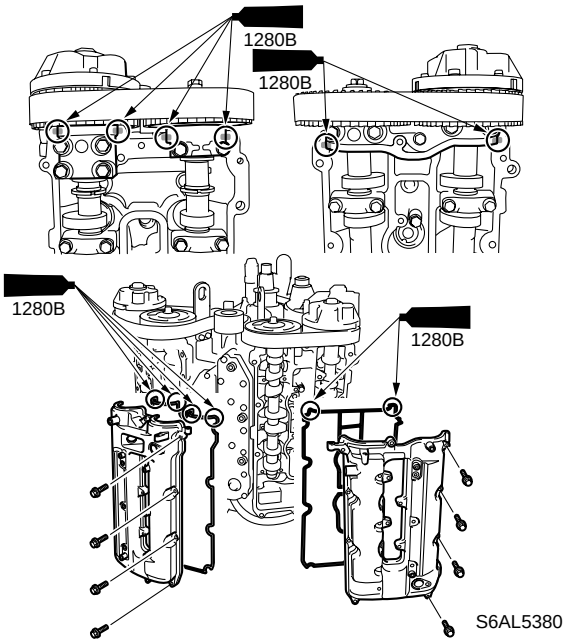
21. Turn the crankshaft clockwise 2 full turns, and then check that alignment marks ⓐ through ⓓ are aligned.



S6P25725

NOTE:
After installing the timing belt, check the valve clearances. To check the valve clearance, see Chapter 5, “Checking the valve clearance.”

22. Install the cylinder head covers, and then tighten the bolts to the specified torque in 2 stages.

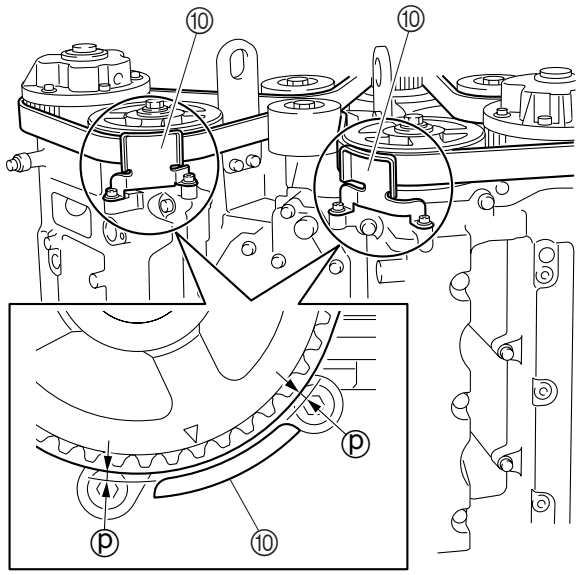


S6AL5380

NOTE:
- Apply sealant to the edge of the cylinder head cover gasket before installation.
- Tighten the cylinder head cover bolts to the same torque in both stages.
- See the exploded diagram (5-7).

Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

23. Install the timing belt guides ⑩, and then adjust the timing belt-to-timing belt guide clearance Ⓟ.



S6AL5390

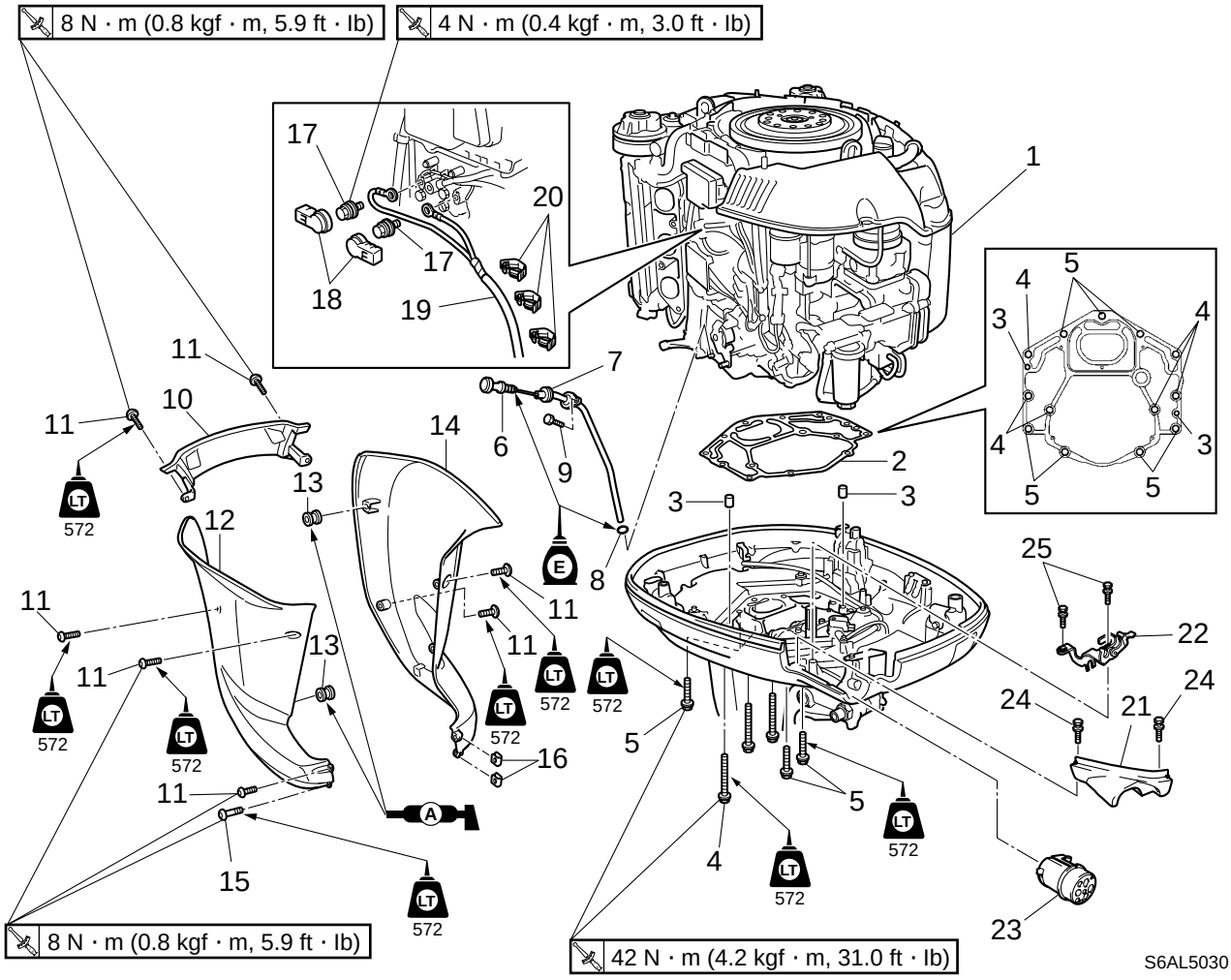
NOTE:
If the valve clearances are adjusted or any parts related to valve movement are replaced after installing the timing belt, check the valve clearances. To check the valve clearance, see Chapter 5, “Checking the valve clearance.”

Timing belt-to-timing belt guide clearance Ⓟ:
1.0 ± 0.5 mm (0.04 ± 0.02 in)

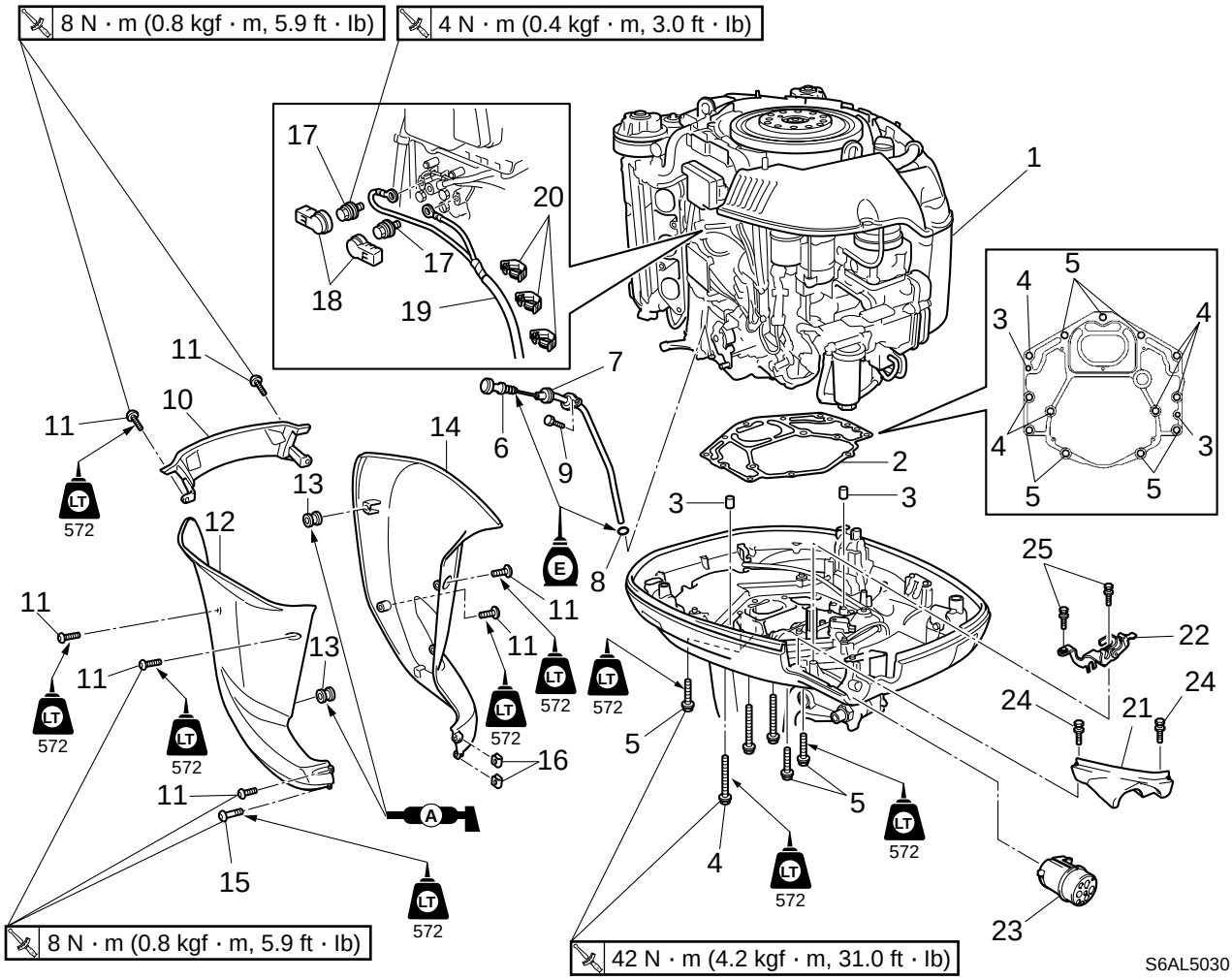
5

Power unit

Power unit assembly

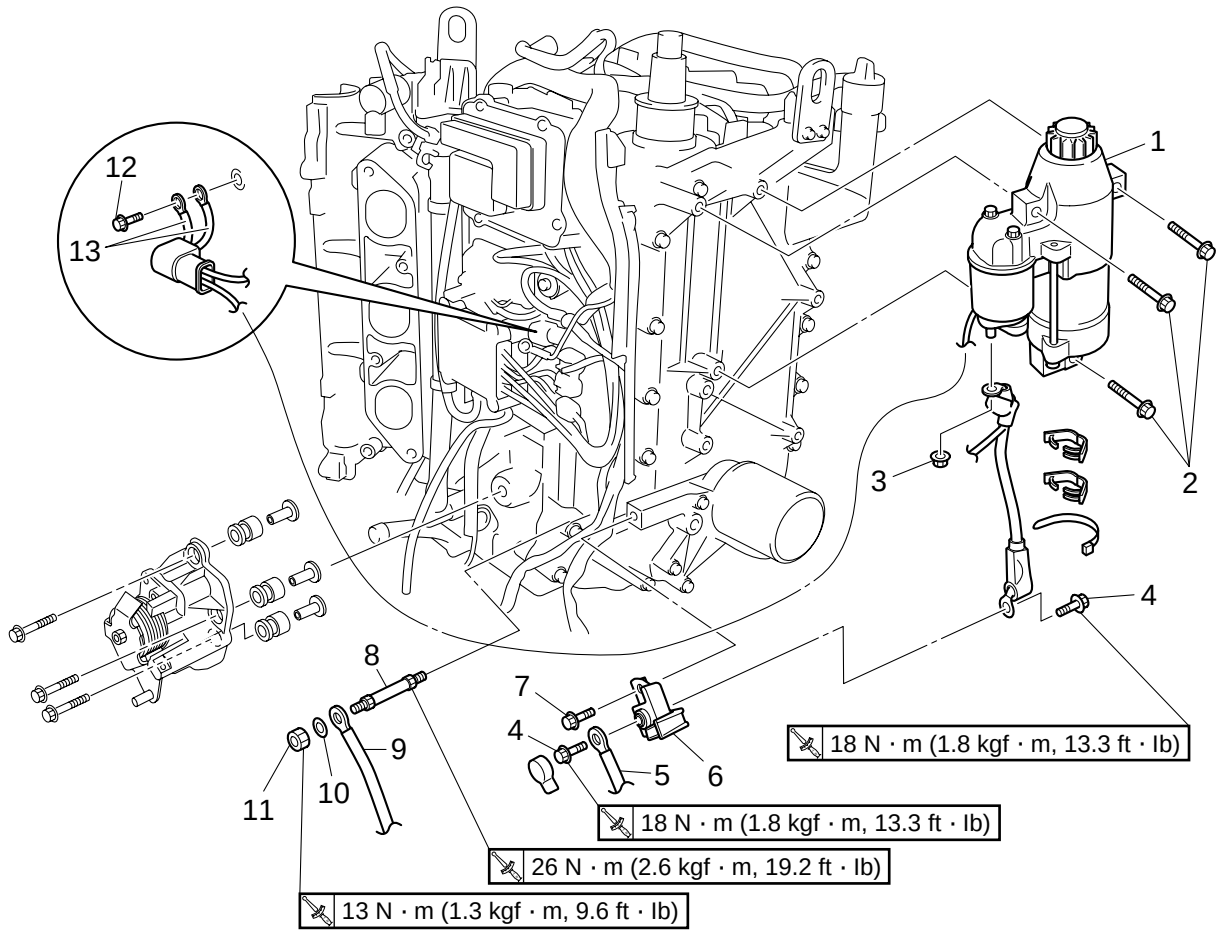


No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Gasket	1	**Not reusable**
3	Dowel	2	
4	Bolt	6	M10 × 140 mm
5	Bolt	7	M10 × 35 mm
6	Oil dipstick	1	
7	Dipstick guide	1	
8	O-ring	1	**Not reusable**
9	Bolt	1	M6 × 20 mm
10	Upper case cover	1	
11	Bolt	7	M6 × 14 mm
12	Apron (STBD)	1	
13	Grommet	6	
14	Apron (PORT)	1	
15	Bolt	1	M6 × 30 mm
16	Nut	2	
17	Bolt	2	M6 × 10 mm



No.	Part name	Q'ty	Remarks
18	Cap	2	
19	PTT motor lead	1	
20	Clamp	3	
21	Retaining plate	1	
22	Cable holder	1	
23	Grommet	1	
24	Bolt	2	M6 × 30 mm
25	Bolt	2	M6 × 20 mm

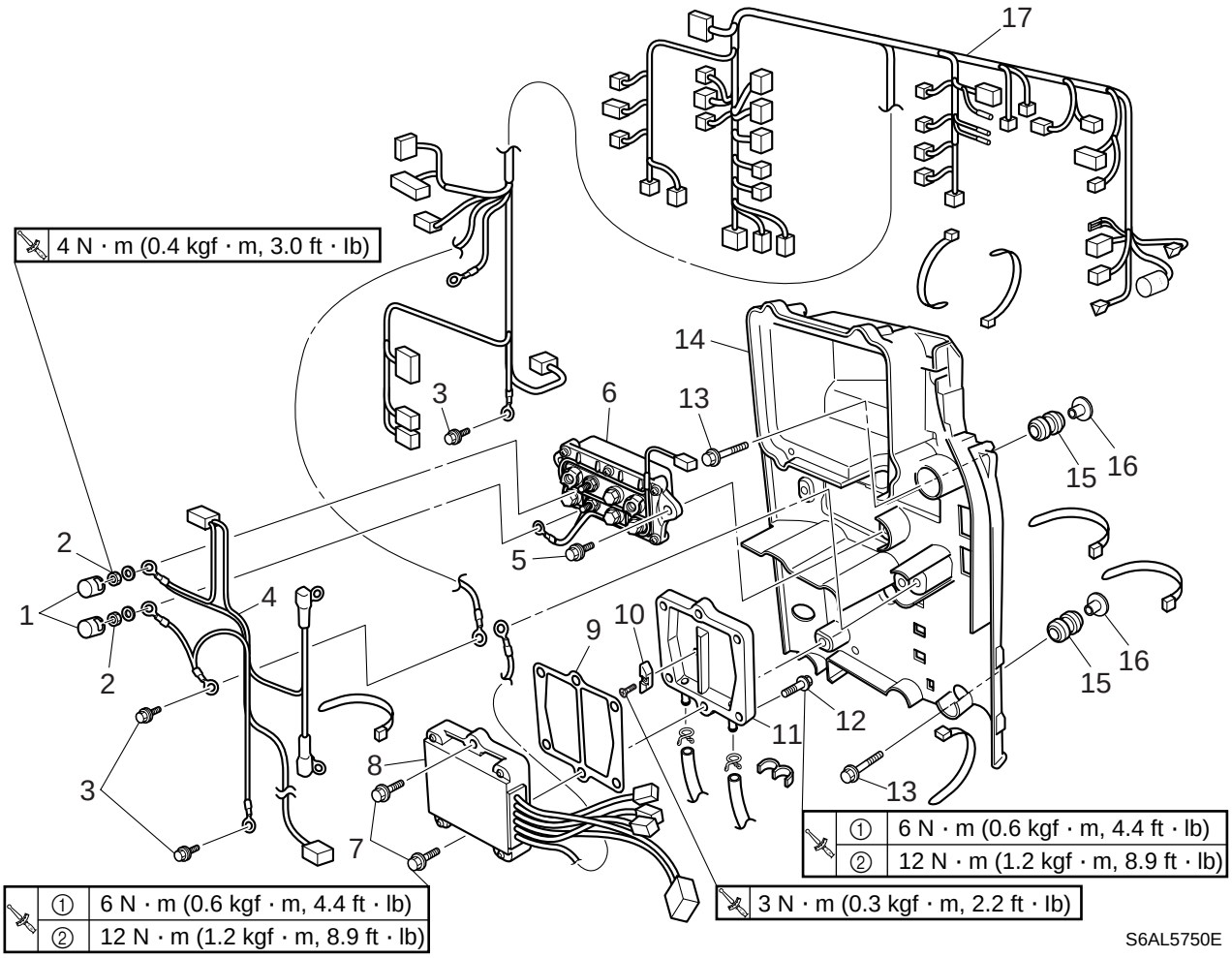
Starter motor



S6AL5640

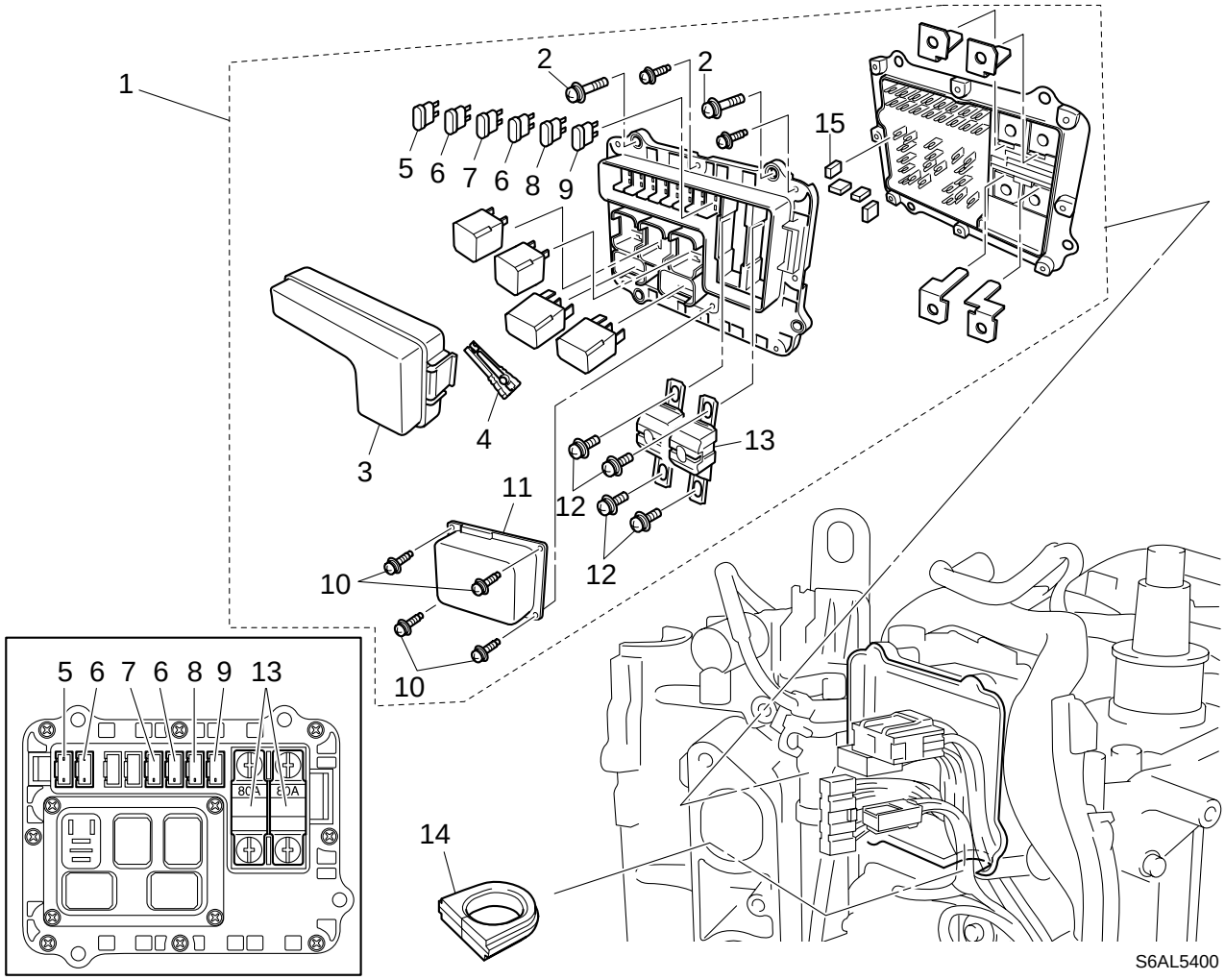
No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Nut	1	
4	Bolt	2	M8 × 16 mm
5	Positive battery cable	1	
6	Terminal	1	
7	Bolt	1	M8 × 20 mm
8	Terminal bolt	1	
9	Negative battery cable	1	
10	Washer	1	
11	Nut	1	
12	Bolt	1	M6 × 20 mm
13	Starter motor lead	2	

Junction box



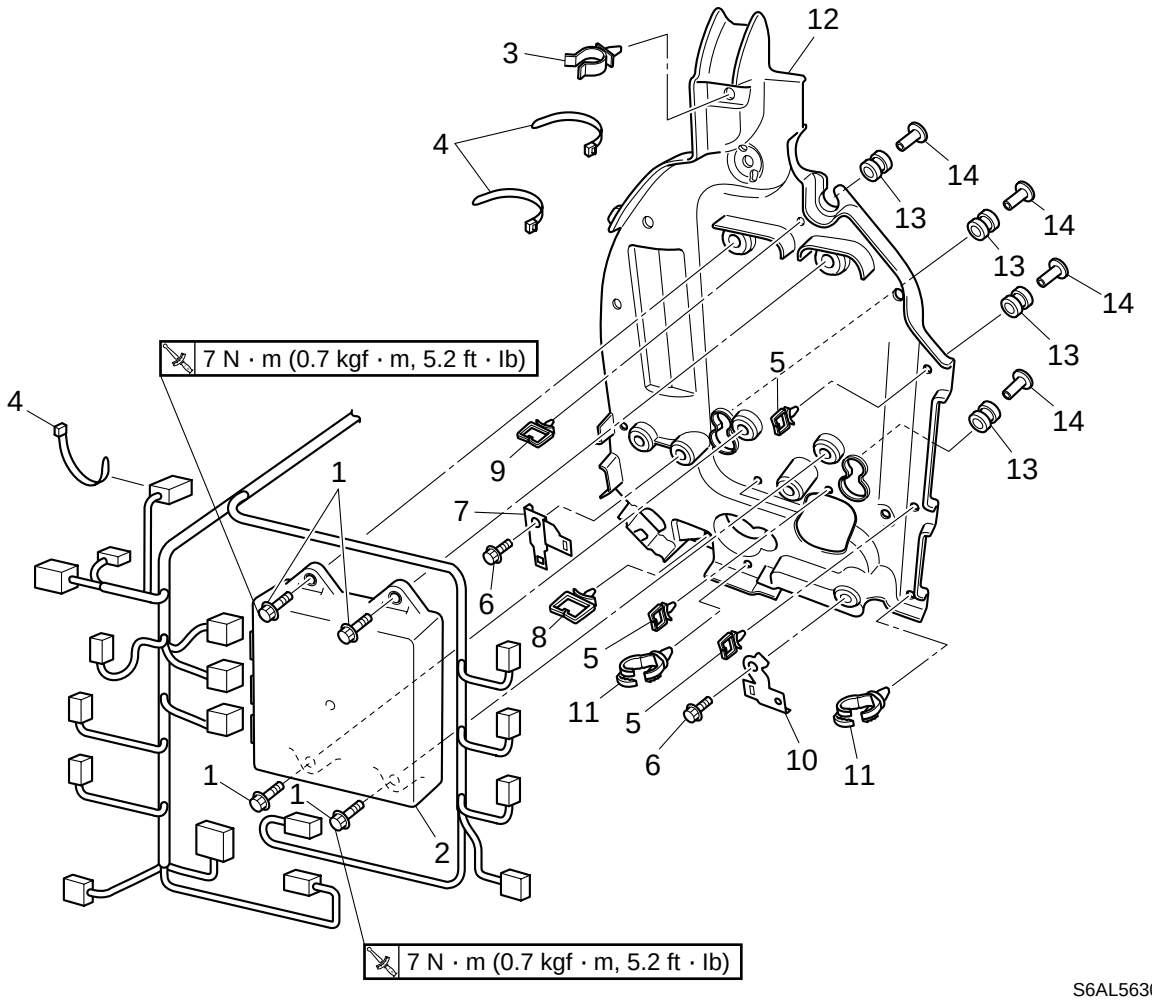
No.	Part name	Q'ty	Remarks
1	Cap	2	
2	Nut	2	
3	Bolt	3	M6 × 20 mm
4	Sub wiring harness	1	
5	Bolt	2	M6 × 25 mm
6	PTT relay	1	
7	Bolt	2	M6 × 35 mm
8	Rectifier Regulator	1	
9	Gasket	1	**Not reusable**
10	Anode	1	
11	Cover	1	
12	Bolt	4	M6 × 25 mm
13	Bolt	5	M6 × 28 mm
14	Junction box	1	
15	Grommet	5	
16	Collar	5	
17	Wiring harness	1	

Fuse box



No.	Part name	Q'ty	Remarks
1	Fuse box assembly	1	
2	Screw	4	ø5 × 20 mm
3	Cover	1	
4	Fuse puller	1	
5	Fuse	2	10 A, Spare is included.
6	Fuse	3	30 A, Spare is included.
7	Fuse	2	20 A, Spare is included.
8	Fuse	2	5 A, Spare is included.
9	Fuse	2	15 A, Spare is included.
10	Screw	4	ø3 × 10 mm
11	Cover	1	
12	Screw	4	ø5 × 10 mm
13	Fuse	3	80 A, Spare is included.
14	Grommet	1	
15	Terminal	20	

ECM



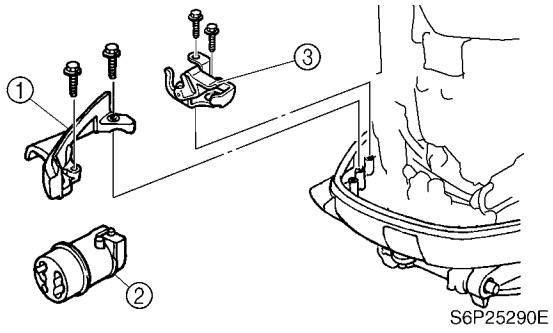
S6AL5630

No.	Part name	Q'ty	Remarks
1	Bolt	4	M6 × 20 mm
2	ECM	1	
3	Holder	1	
4	Plastic tie	3	
5	Holder	4	
6	Bolt	2	M6 × 16 mm
7	Plate	1	
8	Holder	1	
9	Holder	1	
10	Plate	1	
11	Holder	2	
12	ECM bracket	1	
13	Grommet	4	
14	Collar	4	

Removing the power unit

NOTE:
- Be sure to reduce the fuel pressure before removing the power unit. To reduce the fuel pressure, see Chapter 4, “Reducing the fuel pressure.”
- It is recommended to loosen the flywheel magnet nut before removing the power unit to improve working efficiency.

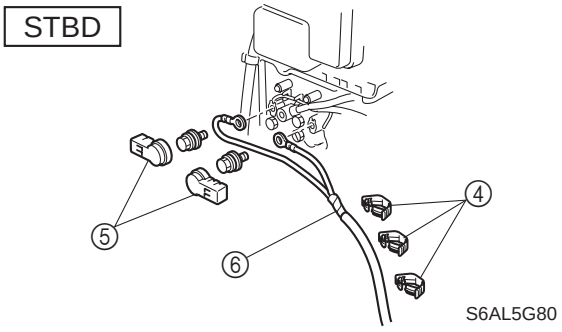
1. Remove the flywheel magnet cover.
2. Remove the retaining plate ①, grommet ②, and cable holder ③, and then disconnect the remote control cables.



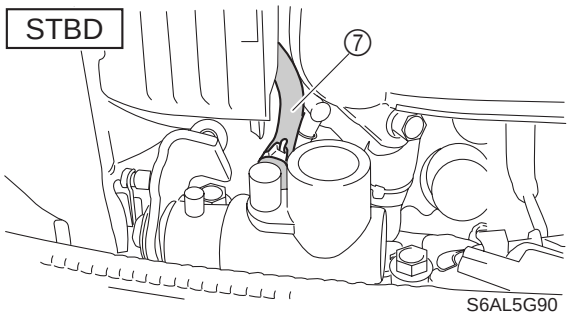
3. Remove the starboard intake manifold.

NOTE:
See the exploded diagram (4-9).

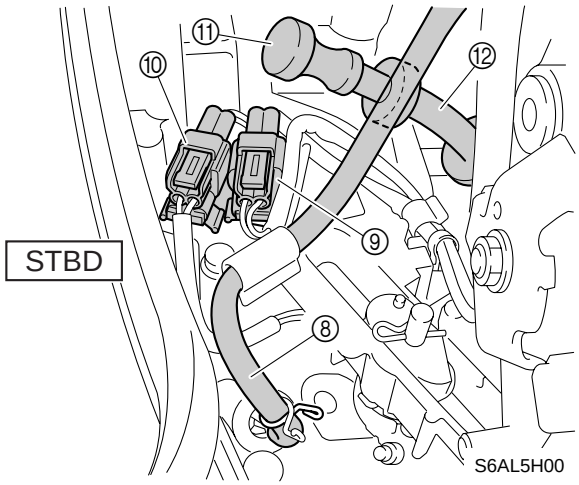
4. Remove the clamps ④ and caps ⑤, and then disconnect the PTT motor lead ⑥.



5. Disconnect the vapor gas hose ⑦ from the starboard top cowling lock.



6. Disconnect the cooling water pilot hose ⑧.
7. Remove the neutral switch coupler (blue) ⑨ from the bracket, and disconnect the neutral switch coupler and shift cut switch coupler (black) ⑩.
8. Remove the oil dipstick ⑪ and dipstick guide ⑫.

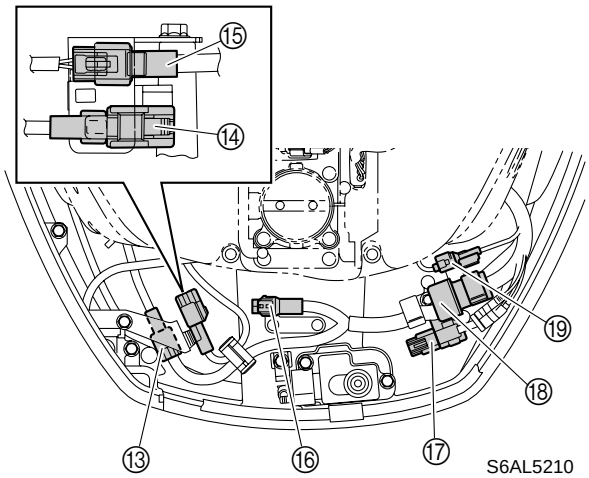


9. Disconnect the battery cables.

NOTE:
See the exploded diagram (5-35).

10. Disconnect the fuel hose from the fuel filter.

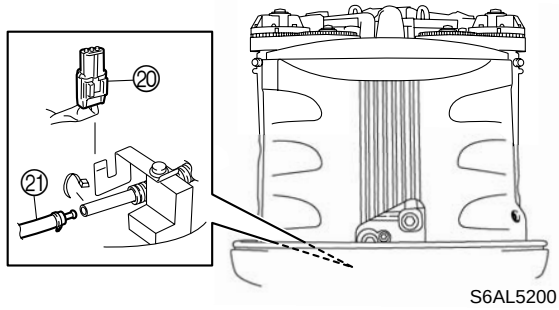
11. Removing the PTT switch coupler ⑬, isolator coupler ⑭, water detection switch coupler (blue) ⑮, warning indicator coupler ⑯, LAN communication coupler (white) ⑰, 10-pin main harness coupler ⑱, and trim sensor coupler ⑲ from the brackets, and then disconnect them.



S6AL5210

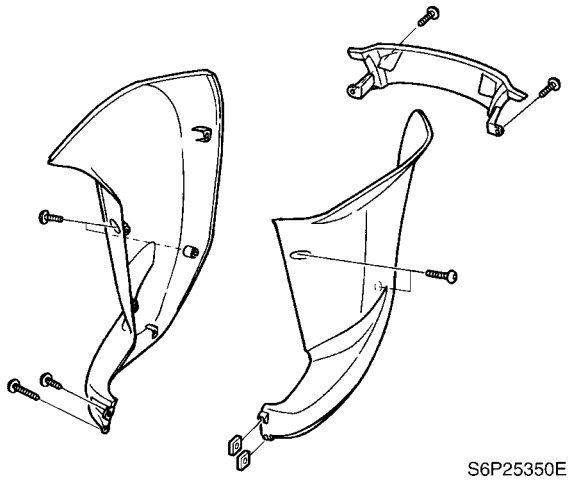
12. Remove the speed sensor coupler ⑳ from the bracket, and then disconnect it.

13. Disconnect the flushing hose ㉑.

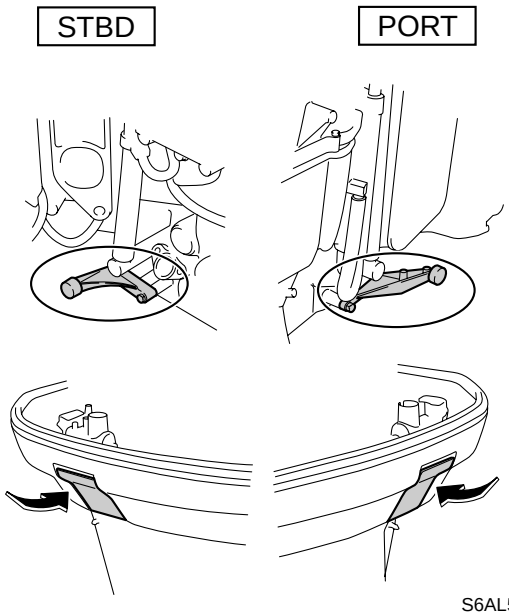


S6AL5200

14. Remove the aprons and upper case cover.


S6P25350E

15. Retract the port and starboard top cowling lock levers.



S6AL5220

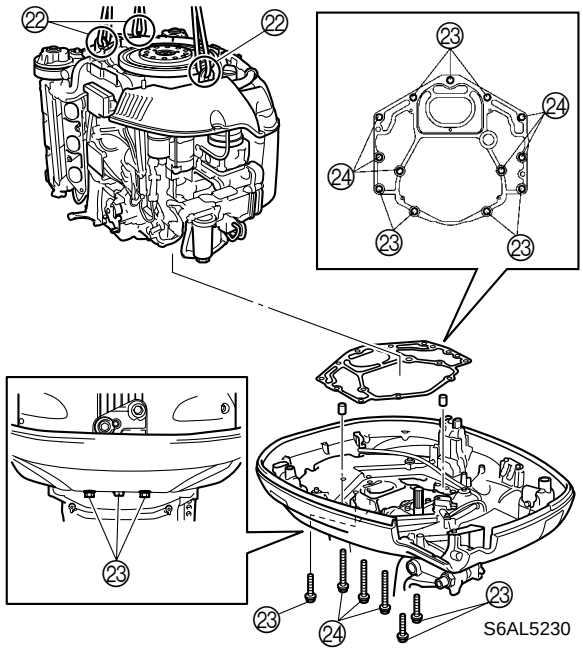
CAUTION:

Make sure that the top cowling lock levers are retracted and the engine stoppers are installed before removing the power unit, otherwise the fuel rails could be damaged.

5

16. Suspend the power unit from the engine hangers ㉒.

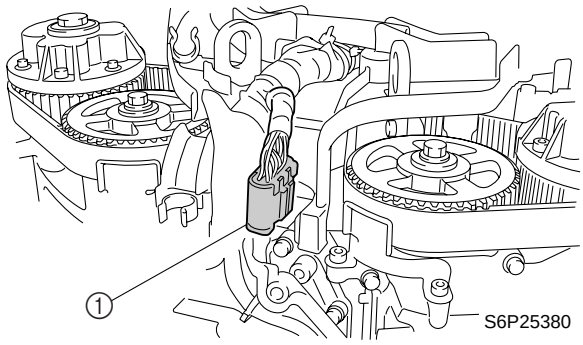
17. Remove the power unit by removing the bolts ㉓ and ㉔.



Removing the wiring harness

NOTE:
When removing the wiring harness and wiring harness guide, the fuel line must be disconnected, so be sure to reduce the fuel pressure before performing the disassembly procedure. To reduce the fuel pressure, see Chapter 4, “Reducing the fuel pressure.”

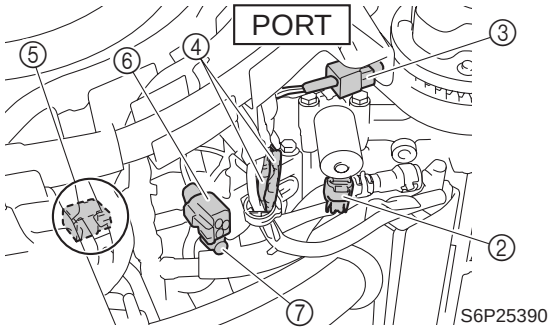
1. Remove the joint connector ① from the wiring harness guide.

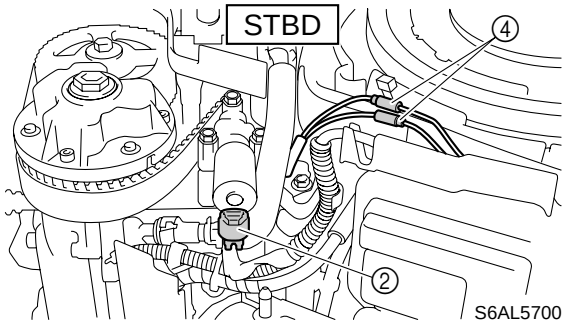


2. Disconnect the oil control valve couplers ②, engine temperature sensor coupler ③, and thermoswitch connectors ④.

3. Remove the engine temperature sensor coupler ③ and low-pressure fuel pump coupler ⑤ from the wiring harness guide.

4. Remove the 3-pin communication coupler ⑥ and diagnosis connector ⑦ from the bracket.



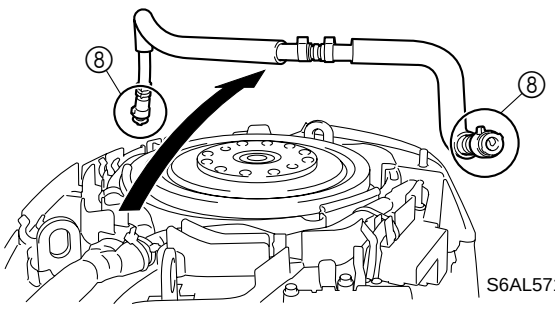


5. Remove the fuel rail covers (port and starboard) and plastic ties.

NOTE:
See the exploded diagram (4-23).

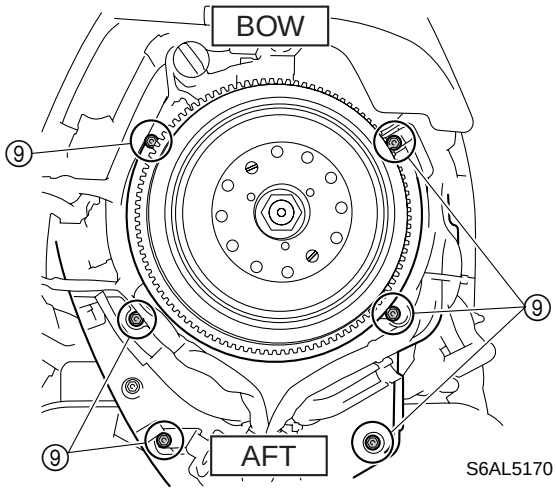
6. Disconnect all fuel injector couplers.

7. Disconnect the quick connectors ⑧ and remove the high-pressure fuel hose assembly (vapor separator-to-starboard fuel rail).

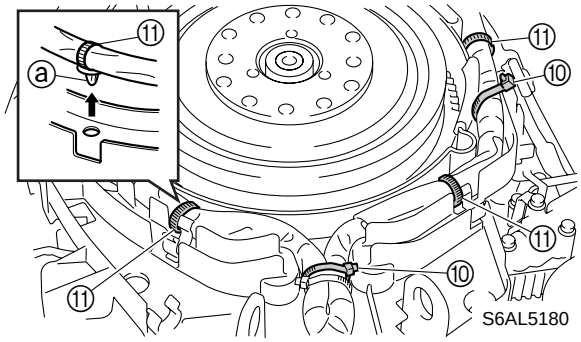


NOTE:
To disconnect the quick connector, see Chapter 4, “Disconnecting the quick connector.”

8. Remove the wiring harness guide bolts ⑨.

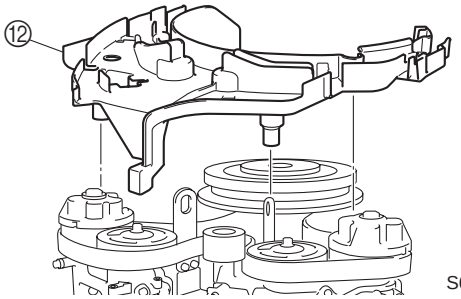


9. Remove the plastic ties ⑩ from the wiring harness and the projections ⓐ on the plastic ties ⑪ from the wiring harness guide, and then pull up the wiring harness.



NOTE:
- When removing the wiring harness guide, the wiring harness does not need to be completely removed.
- To completely remove the wiring harness, see the exploded diagrams (5-4, 5-38).

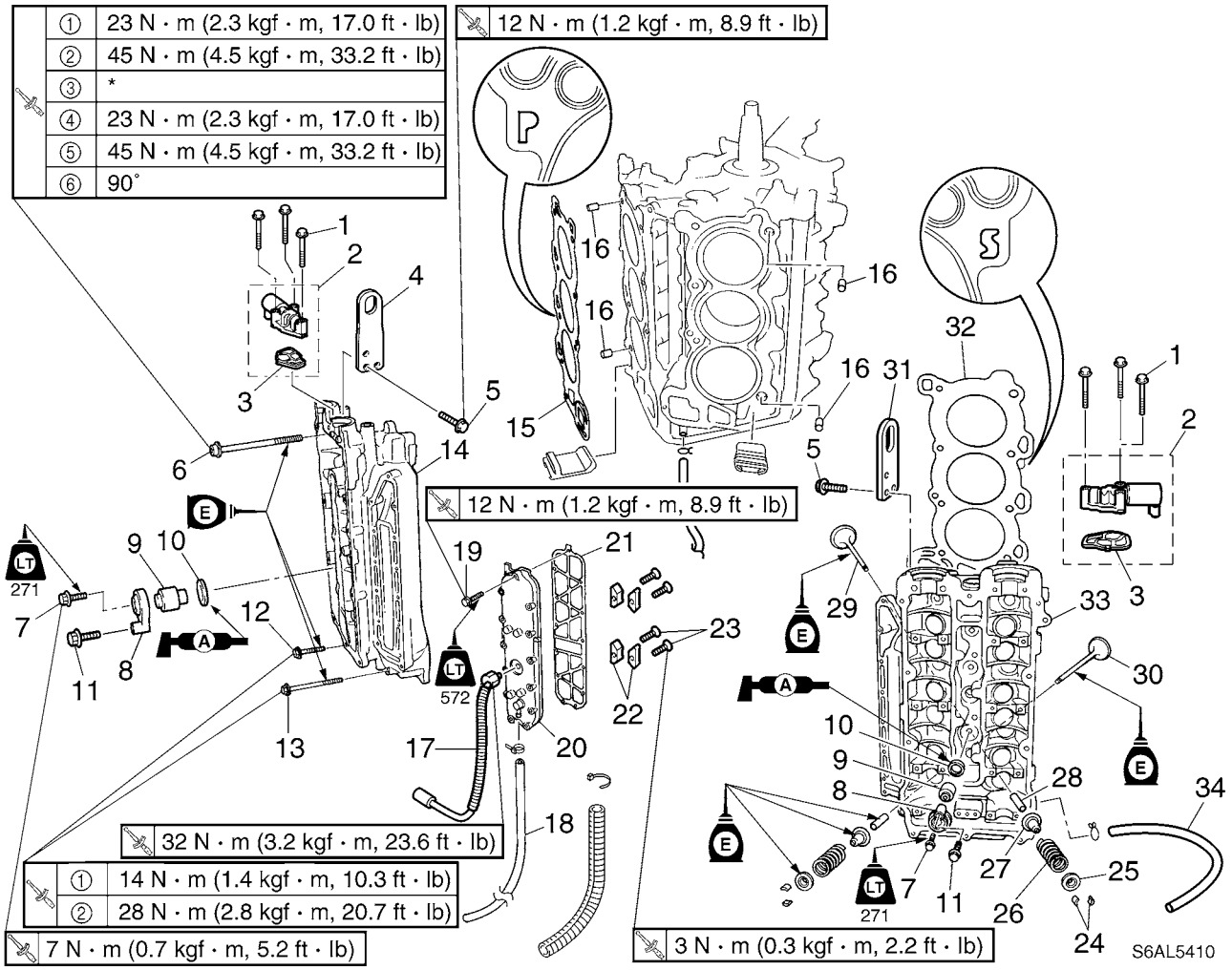
10. Remove the wiring harness guide ⑫.



5

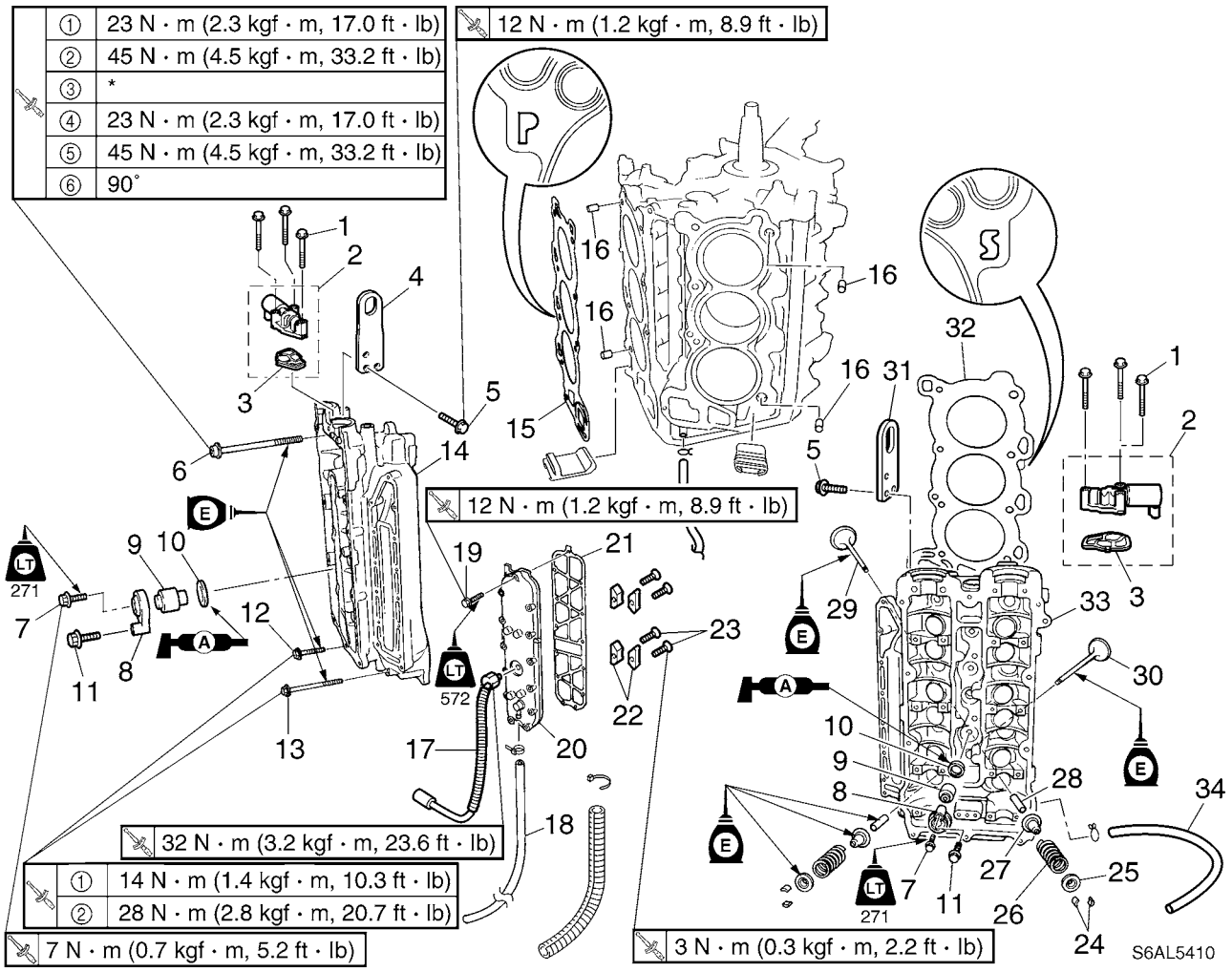
Cylinder head

Cylinder head



No.	Part name	Q'ty	Remarks
1	Bolt	6	M6 × 40 mm
2	Oil control valve assembly	2	
3	Filter	2	**Not reusable**
4	Engine hanger (PORT)	1	
5	Bolt	6	M6 × 20 mm
6	Bolt	16	M10 × 120 mm/T55
7	Bolt	4	M6 × 20 mm
8	Cover	4	
9	Anode	4	
10	Grommet	4	
11	Bolt	4	M8 × 40 mm
12	Bolt	4	M8 × 55 mm
13	Bolt	2	M8 × 90 mm
14	Cylinder head (PORT)	1	
15	Gasket	1	**Not reusable**
16	Collar	4	
17	Knock sensor	1	

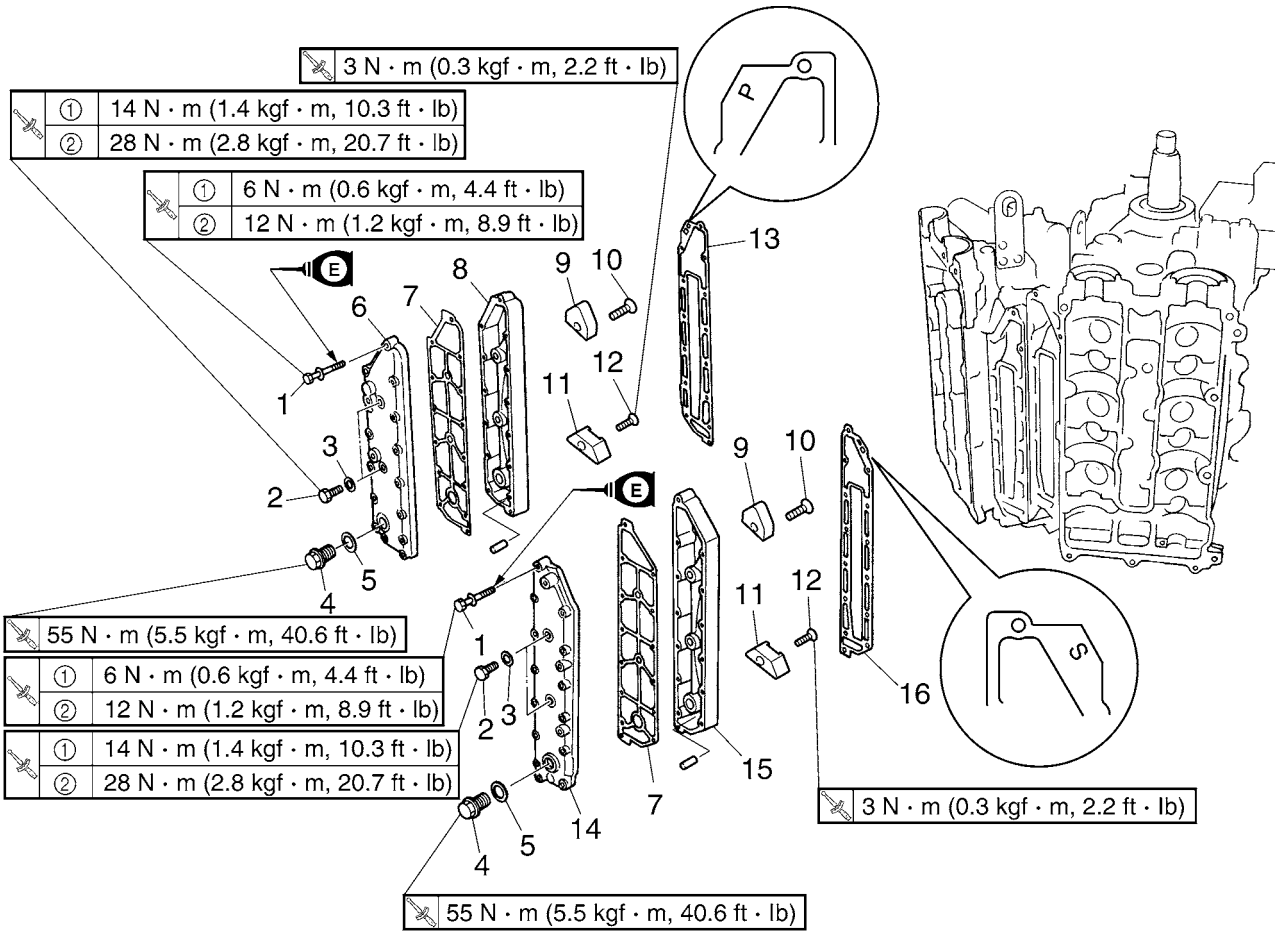
*: Loosen completely



No.	Part name	Q'ty	Remarks
18	Flushing hose	1	
19	Bolt	13	M6 × 30 mm
20	Cooling water passage cover	1	
21	Gasket	1	**Not reusable**
22	Anode	4	
23	Screw	4	ø4 × 12 mm
24	Valve cotter	48	
25	Valve spring retainer	24	
26	Valve spring	24	
27	Valve seal	24	**Not reusable**
28	Valve guide	24	**Not reusable**
29	Intake valve	12	
30	Exhaust valve	12	
31	Engine hanger (STBD)	1	
32	Gasket	1	**Not reusable**
33	Cylinder head (STBD)	1	
34	Cooling water pressure sensor adapter hose	1	

*: Loosen completely

Exhaust cover

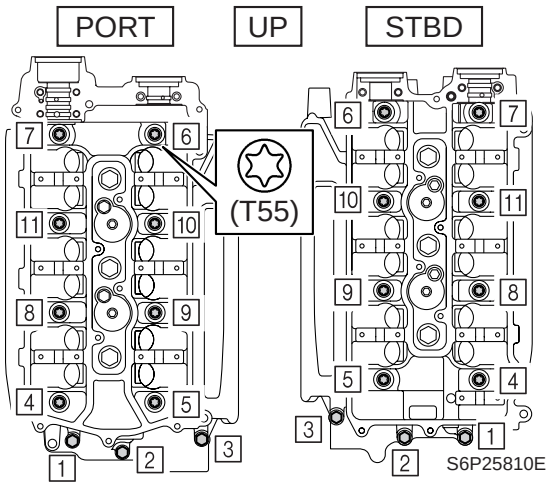


S6P25780E

No.	Part name	Q'ty	Remarks
1	Bolt	28	M6 × 50 mm
2	Plug	4	M8 × 14 mm
3	Gasket	4	**Not reusable**
4	Plug	2	M18 × 17 mm
5	Gasket	2	**Not reusable**
6	Exhaust outer cover (PORT)	1	
7	Gasket	2	**Not reusable**
8	Exhaust inner cover (PORT)	1	
9	Anode	2	
10	Screw	2	ø6 × 16 mm
11	Anode	2	
12	Screw	2	ø4 × 12 mm
13	Gasket	1	**Not reusable**
14	Exhaust outer cover (STBD)	1	
15	Exhaust inner cover (STBD)	1	
16	Gasket	1	**Not reusable**

Removing the cylinder head

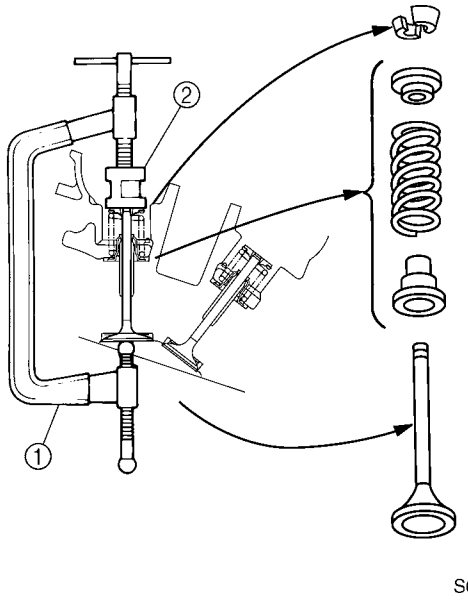
1. Remove the cylinder head bolts in the sequence shown.



CAUTION:

Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.

2. Remove the intake and exhaust valves.



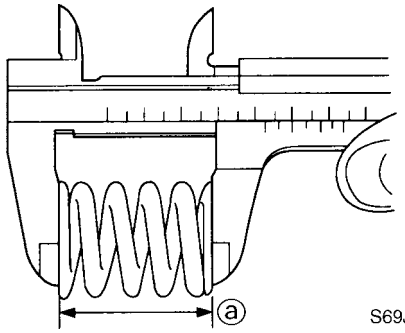
NOTE:

Be sure to keep the valves, springs, and other parts in the order as they were removed.

Valve spring compressor ①:
90890-04019
Valve spring compressor attachment ②:
90890-06320

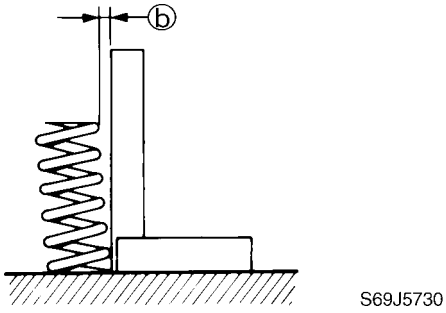
Checking the valve spring

1. Measure the valve spring free length ⓐ. Replace if below specification.



Valve spring free length ⓐ:
44.2 mm (1.74 in)

2. Measure the valve spring tilt ⓑ. Replace if above specification.

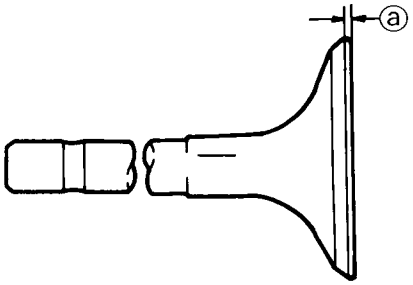


Valve spring tilt limit ⓑ:
1.2 mm (0.05 in)

Checking the valve

1. Check the valve face. Replace if pitted or worn.

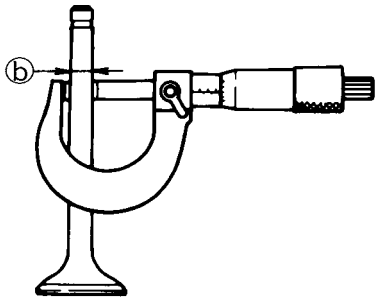
2. Measure the valve margin thickness ⓐ. Replace if out of specification.



S69J5740

Valve margin thickness ⓐ:
Intake:
0.50–0.90 mm (0.020–0.035 in)
Exhaust:
0.90–1.30 mm (0.035–0.051 in)

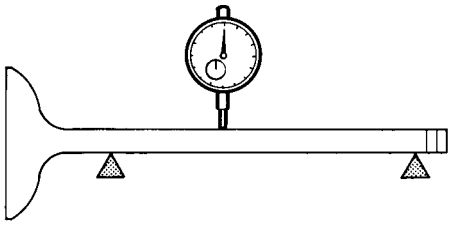
3. Measure the valve stem diameter ⓑ. Replace if out of specification.



S69J5750

Valve stem diameter ⓑ:
Intake:
5.477–5.492 mm
(0.2156–0.2162 in)
Exhaust:
5.464–5.479 mm
(0.2151–0.2157 in)

4. Measure the valve stem runout. Replace if above specification.



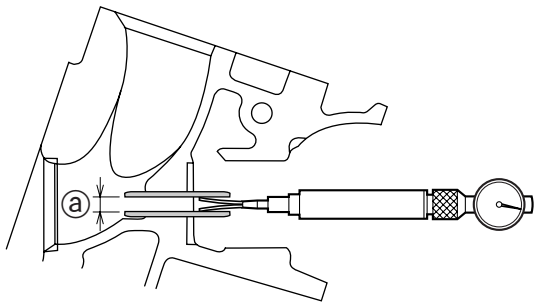
S69J5760

Valve stem runout limit:
0.01 mm (0.0004 in)

Checking the valve guide

NOTE:
Before checking the valve guides, make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter ⓐ.



S69J5770

Valve guide inside diameter ⓐ:
Intake and exhaust:
5.504–5.522 mm
(0.2167–0.2174 in)

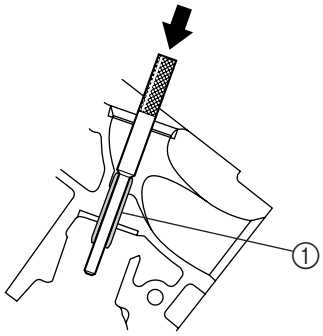
2. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.

Valve stem-to-valve guide clearance = valve guide inside diameter – valve stem diameter:
Intake:
0.012–0.045 mm
(0.0005–0.0018 in)
Exhaust:
0.025–0.058 mm
(0.0010–0.0023 in)

Replacing the valve guide

NOTE:
After replacing a valve guide, check the valve seat contact area. To check the valve seat contact area, see Chapter 5, "Checking the valve seat."

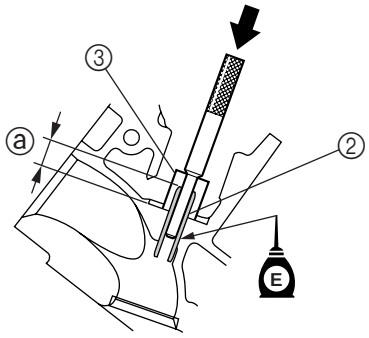
1. Remove the valve guide ① using the special service tool from the combustion chamber side.



S69J5790

Valve guide remover/installer:
90890-06801

2. Install a new valve guide ② using the special service tools from the camshaft side until the valve guide installer ③ to the specified height ⓐ.



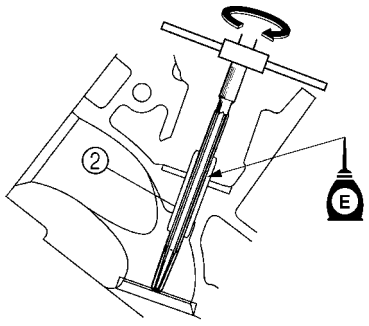
S6P25E30

NOTE:
Apply engine oil to the outer surface of a new valve guide.

Valve guide remover/installer:
90890-06801
Valve guide installer ③:
90890-06810

Valve guide installation position:
Intake and exhaust ⓐ:
13.8 ± 0.2 mm (0.5 ± 0.01 in)

3. Insert the special service tool into the valve guide ②, and then ream the valve guide.



S6AL5420

NOTE:
- Apply engine oil to the inner surface of the valve guide.
- Turn the valve guide reamer clockwise to ream the valve guide.
- Do not turn the reamer counterclockwise when removing the reamer.
- Be sure to clean the valve guide after reaming it.

Valve guide reamer: 90890-06804

4. Measure the valve guide inside diameter.

Valve guide inside diameter:
Intake and exhaust:
5.504–5.522 mm
(0.2167–0.2174 in)

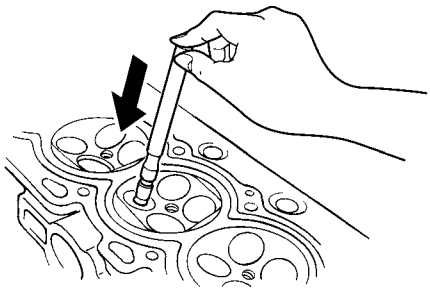
5

Checking the valve seat

1. Eliminate carbon deposits from the valves.

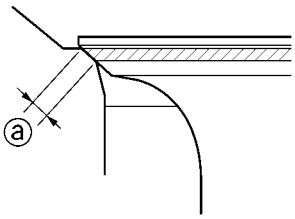
2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.

3. Lap the valve slowly on the valve seat with a valve lapper (commercially available) as shown.

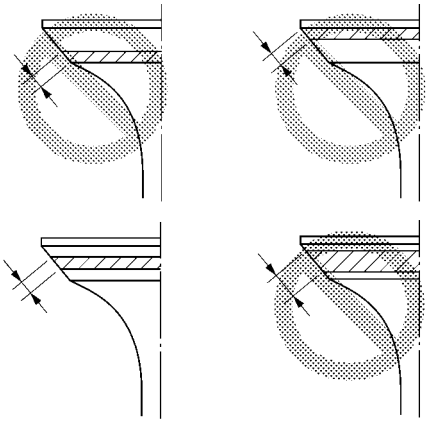


S6P25E40

4. Measure the valve seat contact width ⓐ where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.



S69J5830

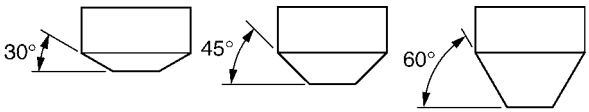


S69J5840

Valve seat contact width ⓐ:
Intake:
1.10–1.40 mm (0.043–0.055 in)
Exhaust:
1.40–1.70 mm (0.055–0.067 in)

Refacing the valve seat

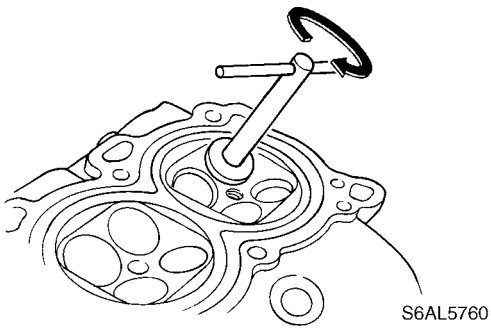
1. Reface the valve seat with the valve seat cutter.

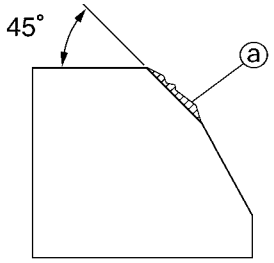


S69J5850

Valve seat cutter holder:
90890-06316
Valve seat cutter:
30° (intake): 90890-06817
30° (exhaust): 90890-06326
45° (intake): 90890-06816
45° (exhaust): 90890-06325
60° (intake and exhaust):
90890-06324

2. Cut the surface of the valve seat with a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.


S6AL5760



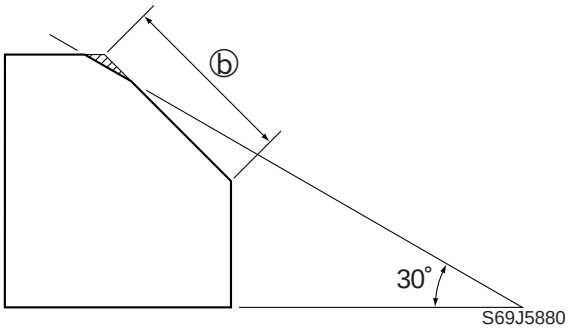
S69J5870

ⓐ Slag or rough surface

CAUTION:

Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

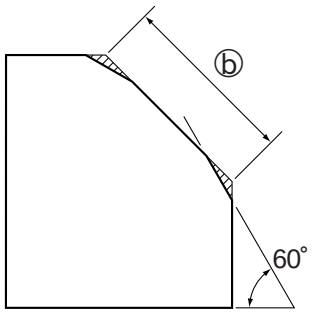
3. Use a 30° cutter to adjust the contact width of the top edge of the valve seat.



S69J5880

ⓑ Previous contact width

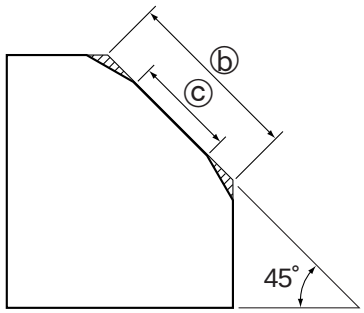
4. Use a 60° cutter to adjust the contact width of the bottom edge of the valve seat.



S69J5890

ⓑ Previous contact width

5. Use a 45° cutter to adjust the contact width of the valve seat to specification.



S69J5900

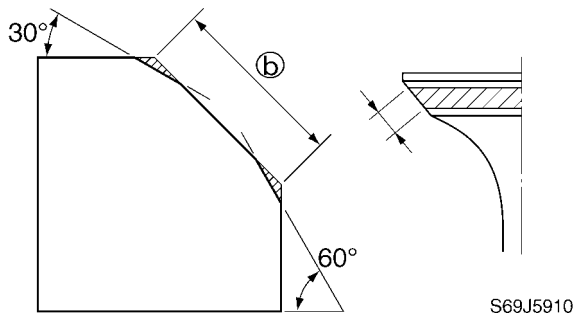
ⓑ Previous contact width
ⓒ Specified contact width

6. Check the valve seat contact area of the valve.

NOTE:

To check the valve seat contact area, see Chapter 5, “Checking the valve seat.”

7. If the valve seat contact width is too wide and situated in the center of the valve face, use a 30° cutter to cut the top edge of the valve seat, a 60° cutter to cut the bottom edge to center the area and set its width.

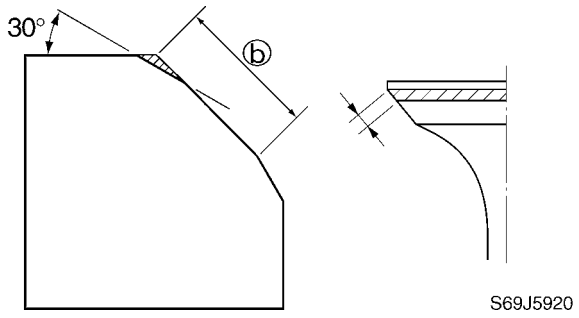


S69J5910

ⓑ Previous contact width

5

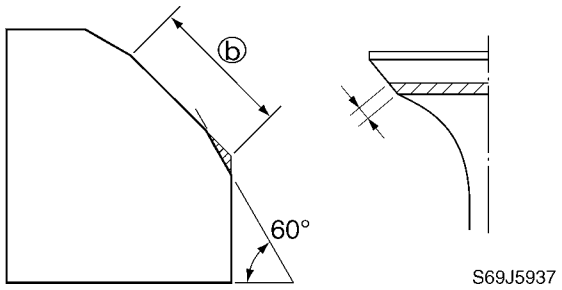
8. If the valve seat contact width is too narrow and situated near the top edge of the valve face, use a 30° cutter to cut the top edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



S69J5920

ⓑ Previous contact width

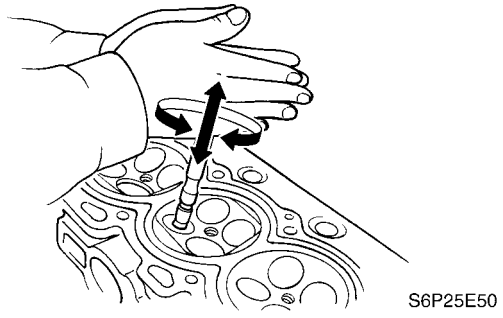
9. If the valve seat contact width is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



S69J5937

ⓑ Previous contact width

10. After refacing the valve seat to the specified contact width, apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially available).


S6P25E50

CAUTION:

Do not get the lapping compound on the valve stem and valve guide.

11. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder heads and the valves.

12. Check the valve seat contact area of the valve again.

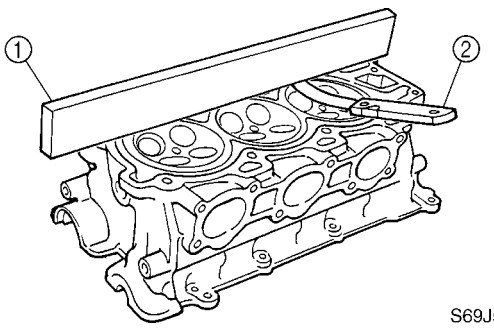
NOTE:

To check the valve seat contact area, see Chapter 5, “Checking the valve seat.”

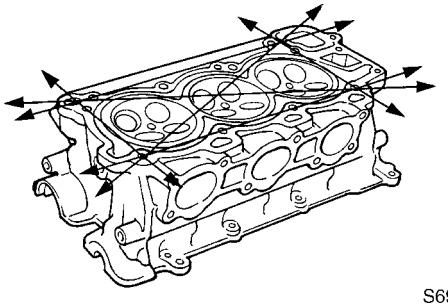
Checking the cylinder head

1. Eliminate carbon deposits from the combustion chambers and check for deterioration.

2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in the directions shown. Replace the cylinder head assembly if above specification.



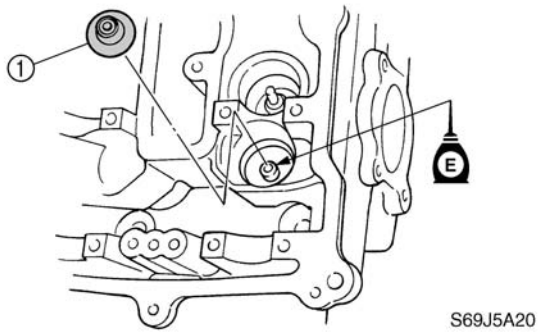
S69J5A00


S69J5A10

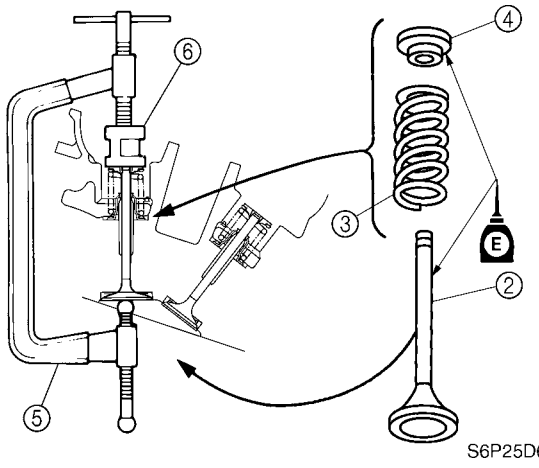
Cylinder head warpage limit:
0.1 mm (0.0039 in)

Installing the valve

1. Install a new valve seal ① onto the valve guide.



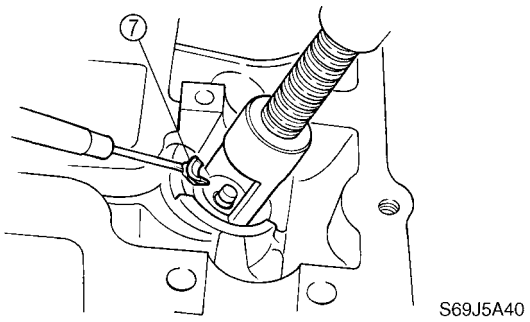
2. Install the valve ②, valve spring ③, and valve spring retainer ④ in the sequence shown, and then attach the special service tools.



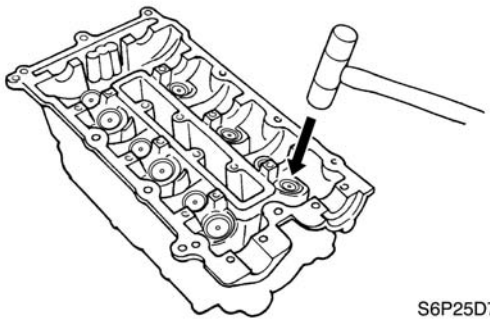
NOTE:
The valve spring can be installed in any direction.

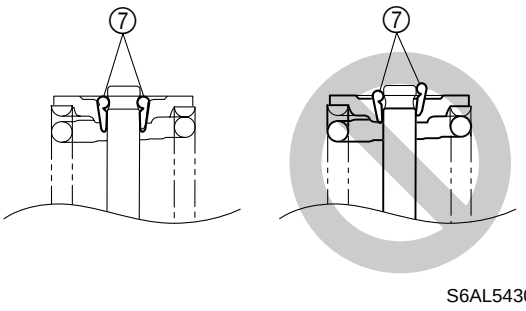
Valve spring compressor ⑤:
90890-04019
Valve spring compressor attachment ⑥:
90890-06320

3. Compress the valve spring, and then install the valve cotters ⑦.



4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotters ⑦ securely.



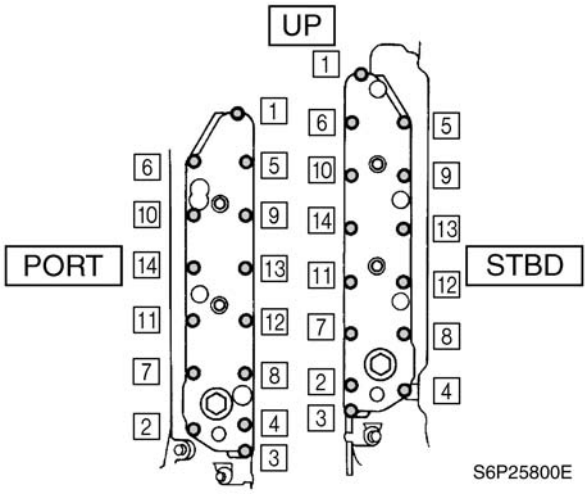


NOTE:
Be sure to install the camshafts after completing the procedure in Chapter 5, “Installing the cylinder head.”

5

Removing the exhaust cover

1. Remove the exhaust cover bolts in the sequences shown.



Checking the exhaust cover anode

1. Check the anodes. Clean if there are scales, grease, or oil.

CAUTION:

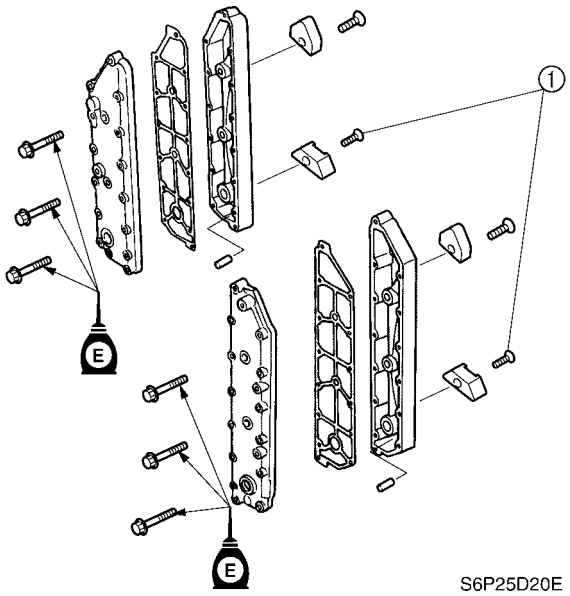
Do not oil, grease, or paint the anodes, otherwise they will be ineffective.

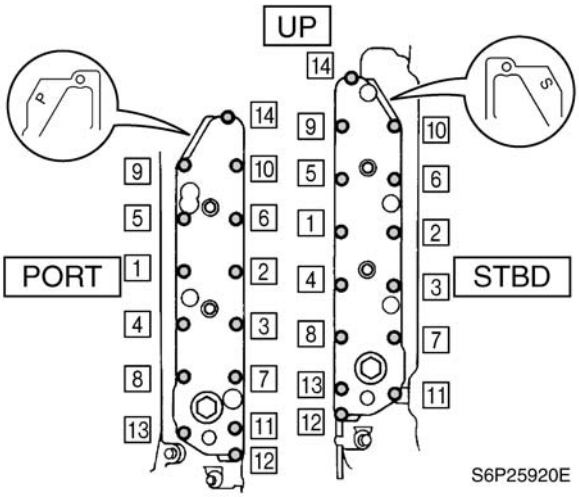
2. Replace the anodes if excessively eroded.

Installing the exhaust cover

1. Install the anodes to the exhaust covers.

2. Install new gaskets and the exhaust covers, and then tighten the bolts to the specified torques in 2 stages and in the sequence shown.





NOTE:

Apply engine oil to the exhaust cover bolts before installation.

	Anode screw ①: 3 N·m (0.3 kgf·m, 2.2 ft·lb) Exhaust cover bolt: 1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb) 2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

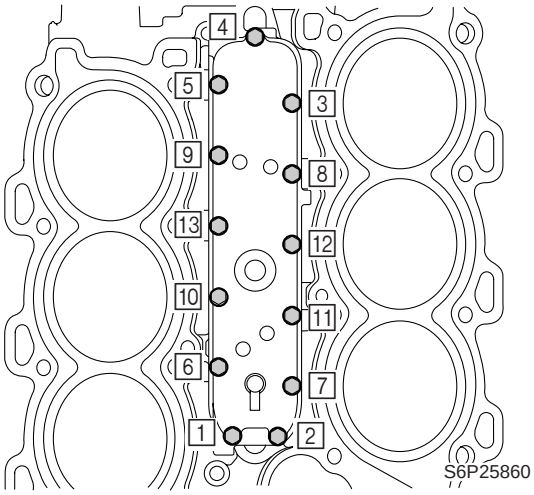
Removing the cooling water passage cover

1. Remove the knock sensor.

NOTE:
To check the knock sensor, see Chapter 8, "Checking the knock sensor."

2. Disconnect the flushing hose.

3. Remove the cooling water passage cover bolts in the sequence shown.



NOTE:
See the exploded diagram (5-43).

Checking the cooling water passage cover anode

1. Check the anodes. Clean if there are scales, grease, or oil.

CAUTION:
Do not oil, grease, or paint the anodes, otherwise they will be ineffective.

2. Replace the anodes if excessively eroded.

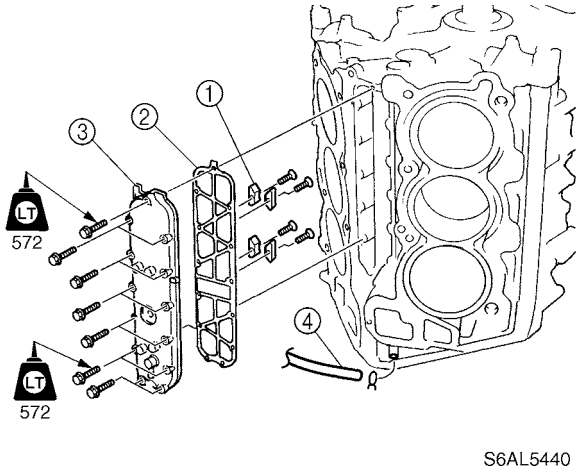
Installing the cooling water passage cover

1. Install the anodes ① to the cooling water passage cover ③.

	Anode screw: 3 N·m (0.3 kgf·m, 2.2 ft·lb)

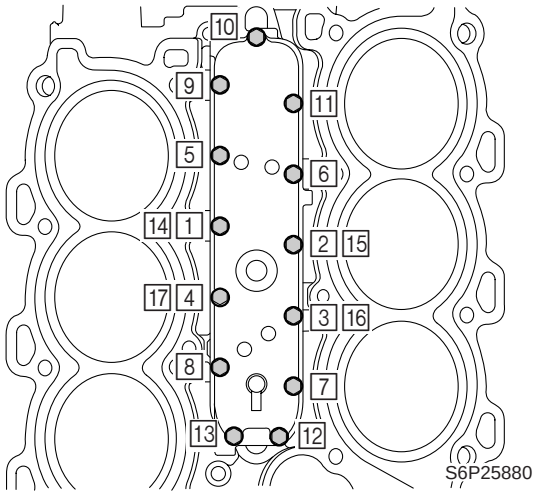
2. Install a new gasket ② and the cooling water passage cover ③.

3. Connect the cooling water hose ④ (cylinder block-to-fuel cooler) to the cylinder block.



NOTE:
See the hose routing (4-3) and exploded diagram (5-43).

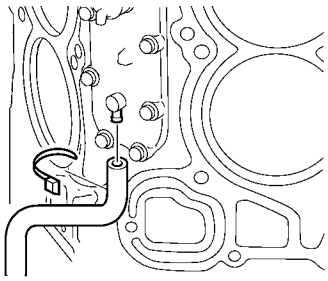
4. Tighten the cooling water passage cover bolts to the specified torque in the sequence shown.



	Cooling water passage cover bolt: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

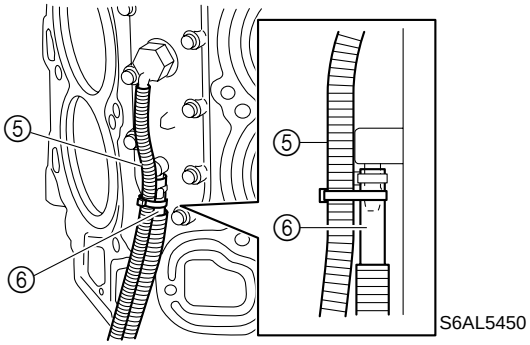
5

5. Connect the flushing hose and fasten it.


S6P25890E

NOTE:
See the hose routing (4-3) and exploded diagram (5-43).

6. Tighten the knock sensor to the specified torque, and then fasten the knock sensor lead ⑤ and flushing hose ⑥ as shown.



S6AL5450

NOTE:
Fasten the knock sensor lead so that it is taut.

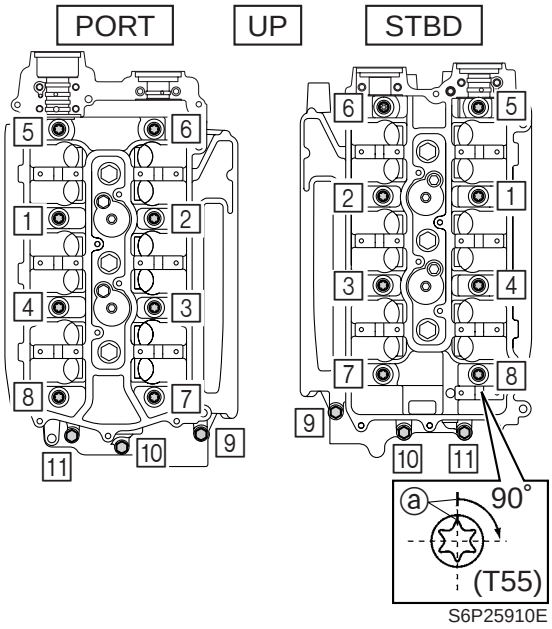
Knock sensor:
32 N·m (3.2 kgf·m, 23.6 ft·lb)

Installing the cylinder head

1. Install the grommets and collars into the cylinder block.

NOTE:
See the exploded diagram (5-43).

2. Install new gaskets and the cylinder heads, and then tighten the bolts to the specified torques in the sequence shown.



S6P25910E

CAUTION:
Do not reuse the cylinder head gaskets, always replace them with new ones.

NOTE:
- Be sure to install the port and starboard cylinder head gaskets onto the correct cylinder heads.
- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M10 bolts [1]–[8] to the specified torques in 6 stages. However, when loosening the bolts in the 3rd stage, loosen them in the opposite order used for tightening. In the 6th stage, make a mark ⓐ on the M10 bolts and the cylinder heads, and then tighten the bolts 90° from the mark.
- After tightening the M10 bolts [1]–[8] has been completed, tighten the M8 bolts [9]–[11] to the specified torques in 2 stages.



Cylinder head bolt 1–8 (M10):
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 45 N·m (4.5 kgf·m, 33.2 ft·lb)
3rd: Loosen completely
4th: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
5th: 45 N·m (4.5 kgf·m, 33.2 ft·lb)
6th: 90°
Cylinder head bolt 9–11 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

3. Install new filters and the oil control valve assemblies.

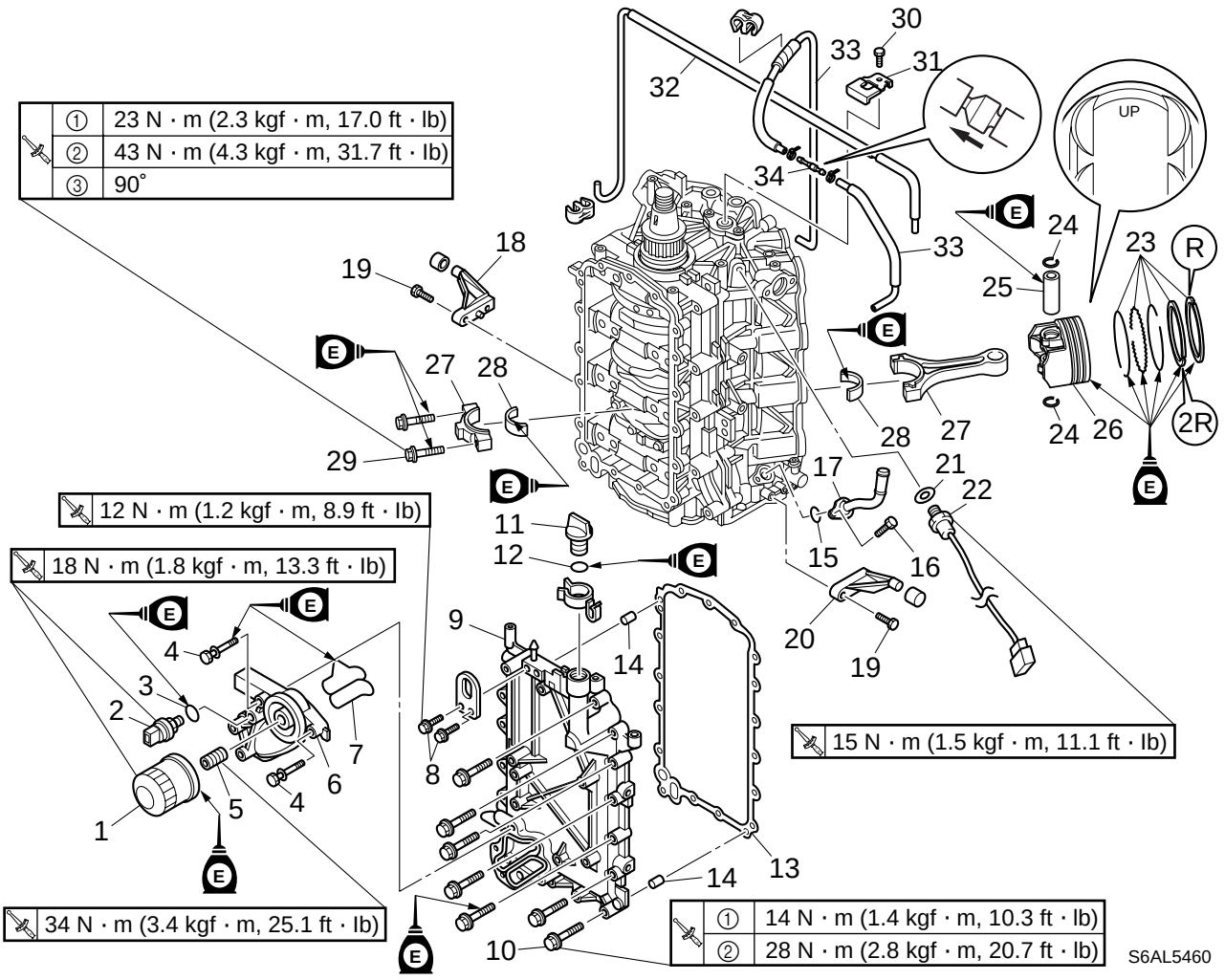
CAUTION:
Do not reuse the oil control valve filters, always replace them with new ones.

NOTE:
Make sure that the oil control valve filter does not come off when installing the oil control valve.

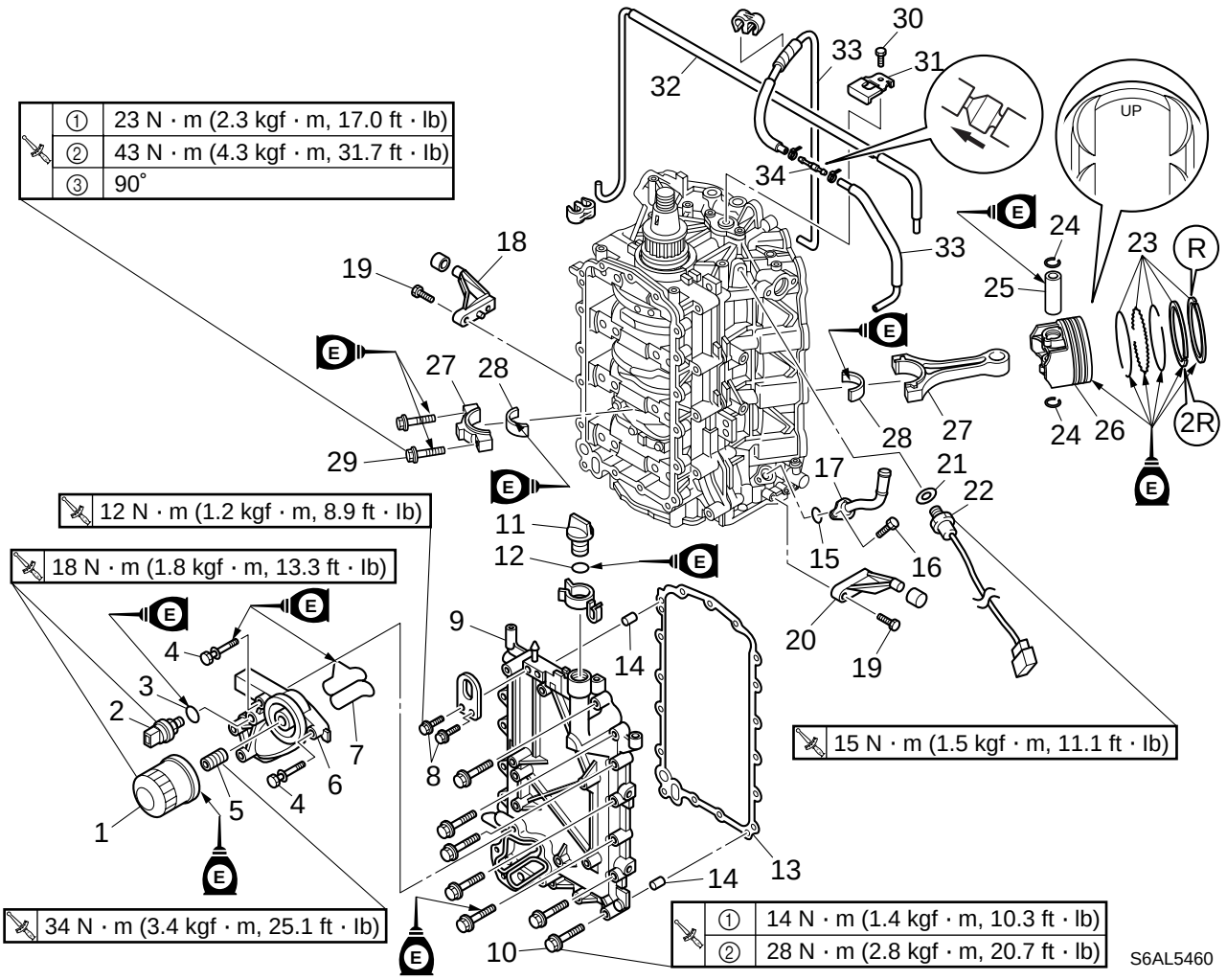
4. Install the camshafts, driven sprockets, and timing belt.

NOTE:
To install the camshafts, driven sprockets, and timing belt, see Chapter 5, “Installing the camshaft, driven sprocket, and timing belt.”

Cylinder block
Crankcase

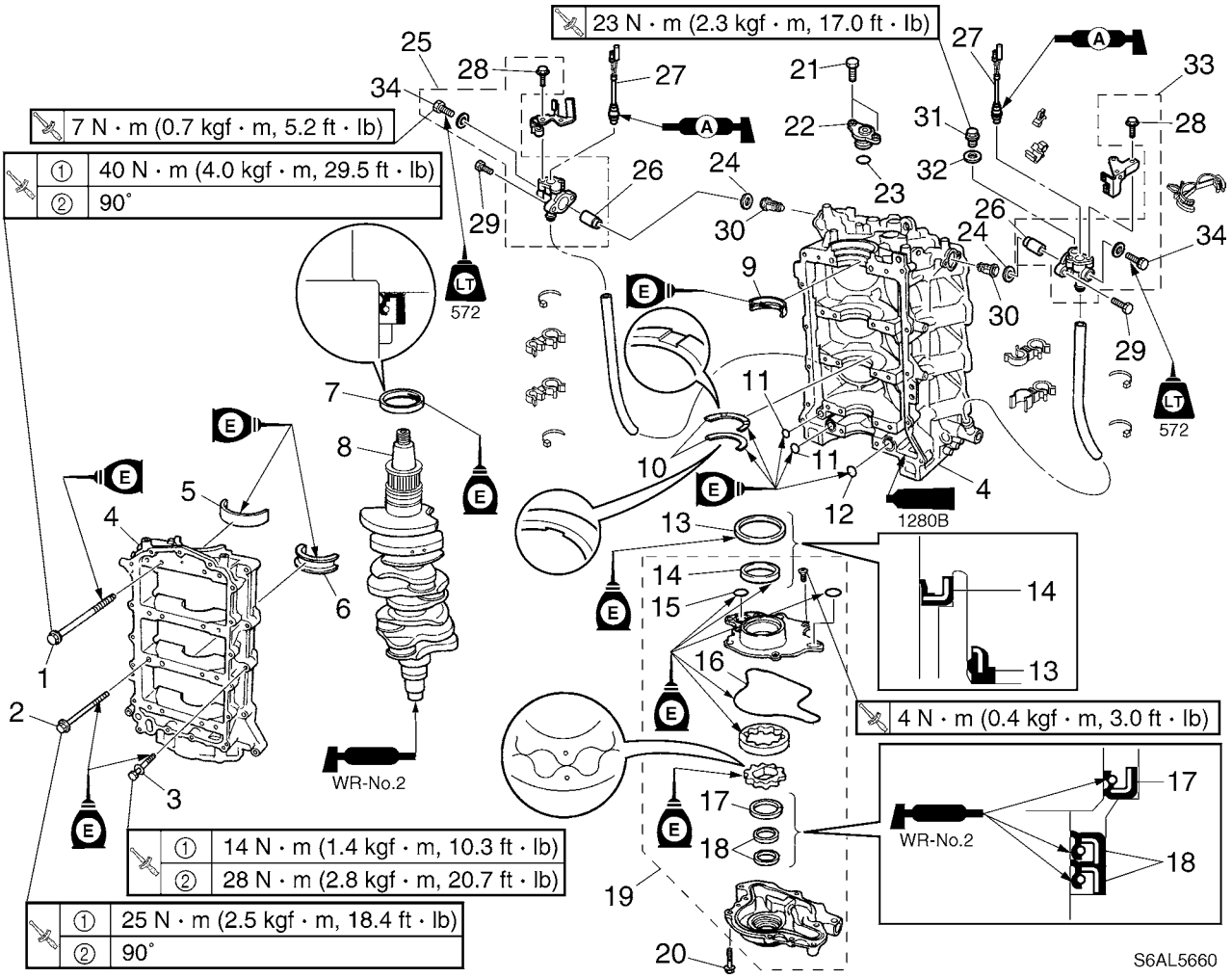


No.	Part name	Q'ty	Remarks
1	Oil filter	1	
2	Oil pressure sensor	1	
3	O-ring	1	**Not reusable**
4	Bolt	5	M6 × 45 mm
5	Joint	1	
6	Oil filter bracket	1	
7	Gasket	1	**Not reusable**
8	Bolt	2	M6 × 20 mm
9	Crankcase cover	1	
10	Bolt	17	M8 × 45 mm
11	Oil filler cap	1	
12	O-ring	1	
13	Gasket	1	**Not reusable**
14	Dowel	2	
15	O-ring	1	**Not reusable**
16	Bolt	1	M6 × 20 mm
17	Blowby hose joint	1	

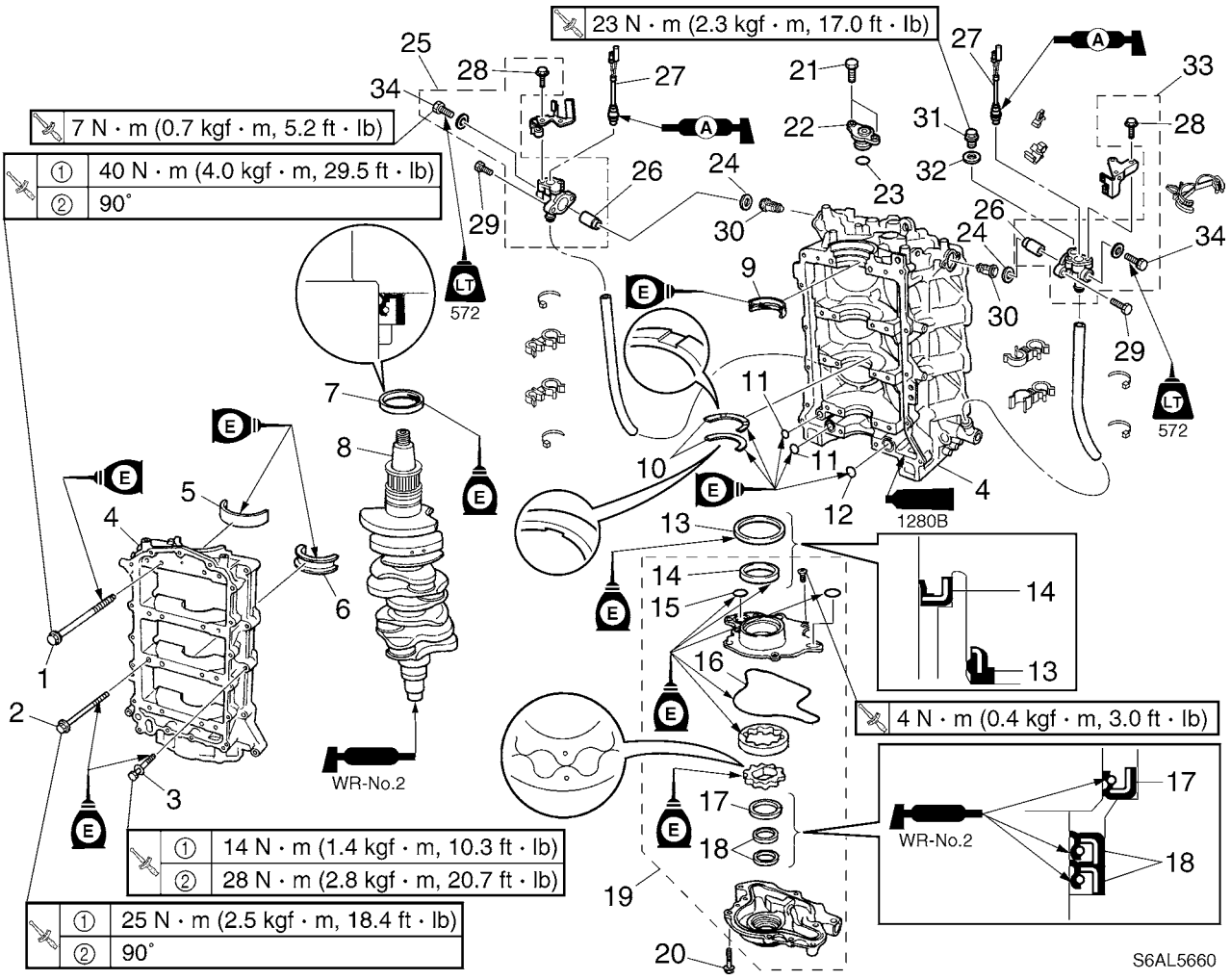


No.	Part name	Q'ty	Remarks
18	Engine stopper (STBD)	1	
19	Bolt	4	M6 × 25 mm
20	Engine stopper (PORT)	1	
21	Washer	1	
22	Engine temperature sensor	1	
23	Piston ring set	6	
24	Clip	12	**Not reusable**
25	Piston pin	6	
26	Piston	6	
27	Connecting rod	6	
28	Connecting rod bearing	12	
29	Bolt	12	M9 × 42 mm **Not reusable**
30	Bolt	1	M6 × 12 mm
31	Holder	1	
32	Cooling water hose	1	
33	Vapor gas hose	2	
34	Check valve	1	

Cylinder block



No.	Part name	Q'ty	Remarks
1	Bolt	8	M10 × 105 mm
2	Bolt	8	M8 × 95 mm
3	Bolt	13	M8 × 55 mm
4	Crankcase assembly	1	
5	Main bearing	3	
6	Main bearing	1	
7	Oil seal	1	Not reusable
8	Crankshaft	1	
9	Main bearing	4	
10	Thrust bearing	2	
11	O-ring	2	Not reusable
12	O-ring	1	Not reusable
13	Oil seal	1	Not reusable
14	Oil seal	1	Not reusable
15	O-ring	2	Not reusable
16	Gasket	1	Not reusable
17	Oil seal	1	Not reusable



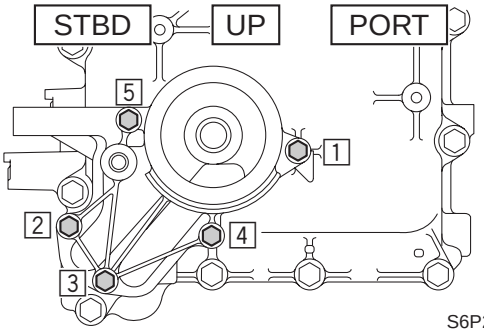
No.	Part name	Q'ty	Remarks
18	Oil seal	2	**Not reusable**
19	Oil pump assembly	1	
20	Bolt	4	M6 × 40 mm
21	Bolt	2	M6 × 20 mm
22	Plug	1	
23	O-ring	1	**Not reusable**
24	Gasket	2	**Not reusable**
25	Thermostat cover (STBD)	1	
26	Anode	2	
27	Thermoswitch	2	
28	Bolt	4	M6 × 16 mm
29	Bolt	4	M6 × 25 mm
30	Thermostat	2	
31	Plug	1	M14 × 12 mm
32	Gasket	1	**Not reusable**
33	Thermostat cover (PORT)	1	
34	Bolt	2	M5 × 20 mm

Disassembling the cylinder block

1. Remove the oil filter using a 72.5 mm (2.9 in) oil filter wrench.

	Oil filter wrench: 90890-06830

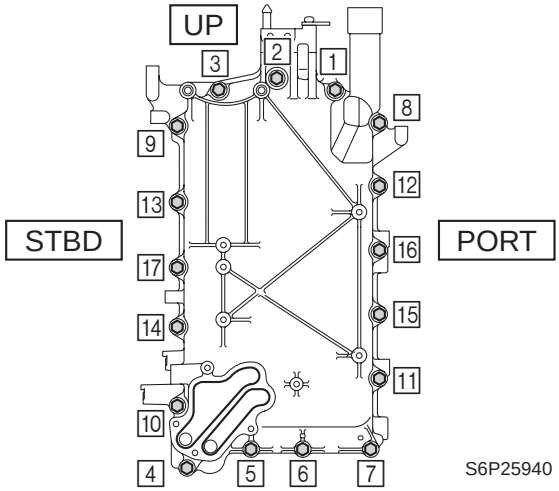
2. Remove the oil filter bracket bolts in the sequence shown.



3. Remove the oil pump.

NOTE:
See the exploded diagram (5-59).

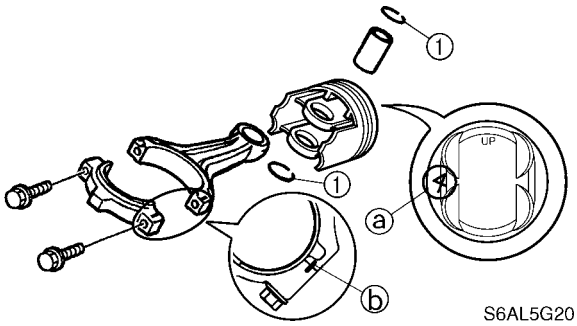
4. Remove the crankcase cover bolts in the sequence shown.



5. Remove the connecting rod cap bolts and the connecting rod caps, and then remove the connecting rod and piston assemblies.

NOTE:
See the exploded diagram (5-57).

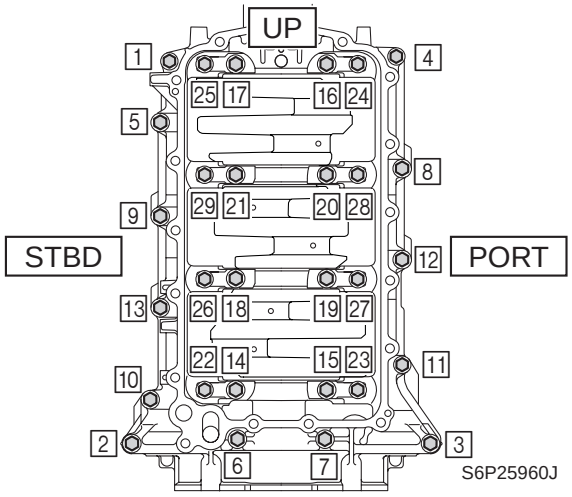
6. Remove the clips ① and piston pin, and then remove the piston.



NOTE:
- See the exploded diagram (5-57).
- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with an identification number ⓐ of the corresponding cylinder.
- Mark each connecting rod and connecting rod cap on the side facing up (flywheel magnet side) with an identification mark ⓑ.
- Do not mix the connecting rods and connecting rod caps. Keep them organized in their proper groups.

7. Remove the piston rings and arrange them in order.

8. Remove the crankcase bolts in the sequence shown.

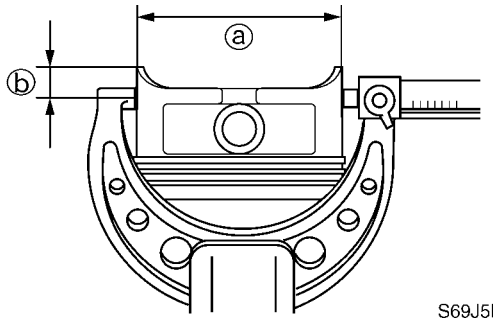


9. Remove the crankshaft and bearings.

NOTE:
Be sure to keep the bearings in the order as they were removed.

Checking the piston diameter

1. Measure the piston outside diameter at the specified measuring point. Replace the piston if out of specification.

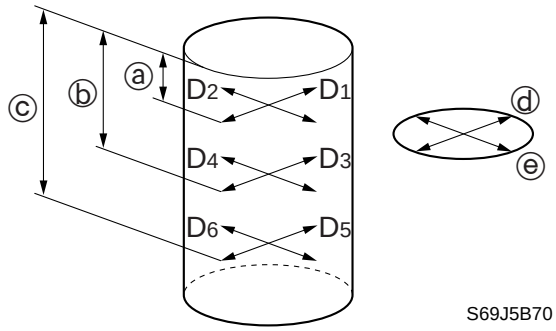


S69J5B60

Piston diameter ⓐ:
93.921–93.941 mm
(3.6977–3.6985 in)
Measuring point ⓑ:
5.0 mm (0.20 in) up from the bottom of the piston skirt

Checking the cylinder bore

1. Measure the cylinder bore (D_1–D_6) at measuring points ⓐ, ⓑ, and ⓒ, and in direction ⓓ (D_1, D_3, D_5), which is parallel to the crankshaft, and direction ⓔ (D_2, D_4, D_6), which is at a right angle to the crankshaft.



S69J5B70

ⓐ 20 mm (0.8 in)
ⓑ 50 mm (2.0 in)
ⓒ 80 mm (3.1 in)

Cylinder bore (D_1–D_6):
94.000–94.017 mm
(3.7008–3.7014 in)

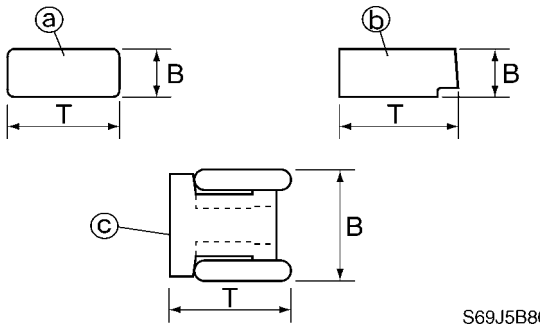
Checking the piston clearance (reference)

1. Check the clearances by referring to the specified values if replacing the piston, the piston rings as a set, the cylinder block, or all parts.

Piston clearance (reference data):
0.075–0.080 mm
(0.0030–0.0031 in)

Checking the piston ring

1. Check the piston ring dimensions B and T. Replace the piston ring set if out of specification.



S69J5B80

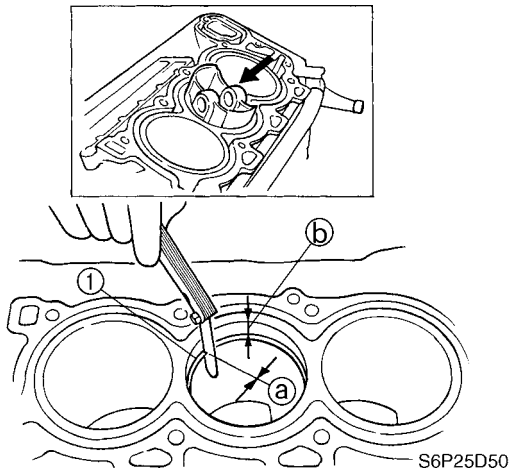
Piston ring dimensions:
Top ring ⓐ:
B: 1.17–1.19 mm
(0.046–0.047 in)
T: 2.80–3.00 mm
(0.110–0.118 in)
Second ring ⓑ:
B: 1.17–1.19 mm
(0.046–0.047 in)
T: 3.70–3.90 mm
(0.146–0.154 in)
Oil ring ⓒ:
B: 2.40–2.47 mm
(0.094–0.097 in)
T: 2.30–2.70 mm
(0.091–0.106 in)

5

Checking the piston ring end gap (reference)

1. Level the piston ring ① in the cylinder with a piston crown.

2. Check the piston ring end gap ⓐ at the specified measuring point ⓑ.

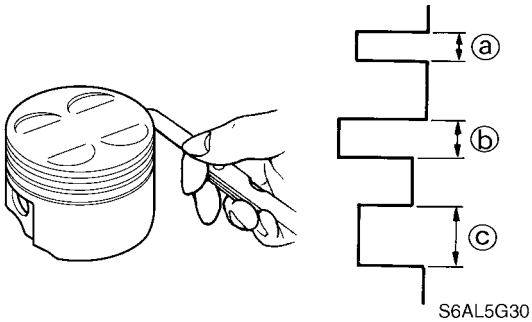


Piston ring end gap ⓐ (reference data):
- Top ring: 0.15–0.30 mm (0.006–0.012 in)
- Second ring: 0.30–0.45 mm (0.012–0.018 in)
- Oil ring: 0.15–0.60 mm (0.006–0.024 in)

Measuring point ⓑ (reference data): 20 mm (0.8 in)

Checking the piston ring groove

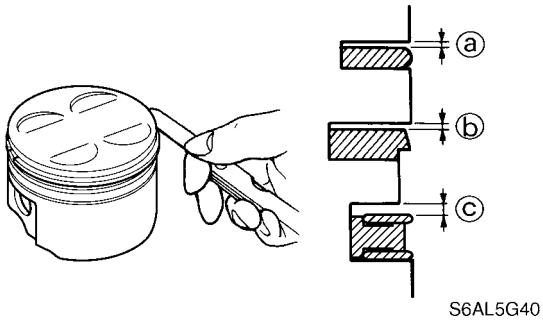
1. Measure the piston ring grooves. Replace the piston if out of specification.



Piston ring groove:
- Top ring ⓐ: 1.23–1.25 mm (0.048–0.049 in)
- Second ring ⓑ: 1.22–1.24 mm (0.048–0.049 in)
- Oil ring ⓒ: 2.51–2.53 mm (0.099–0.100 in)

Checking the piston ring side clearance

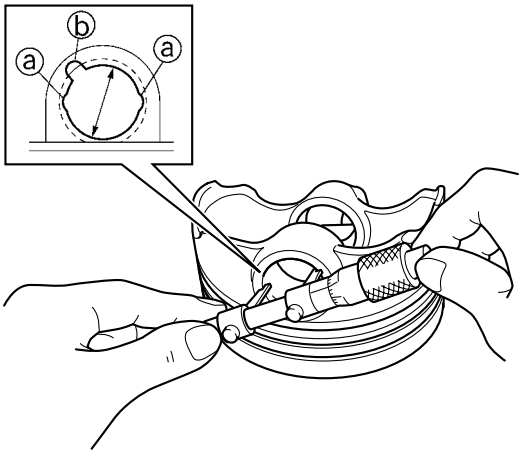
1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.



Piston ring side clearance:
- Top ring ⓐ: 0.04–0.08 mm (0.002–0.003 in)
- Second ring ⓑ: 0.03–0.07 mm (0.001–0.003 in)
- Oil ring ⓒ: 0.04–0.13 mm (0.002–0.005 in)

Checking the piston pin boss bore

1. Measure the piston pin boss bore. Replace the piston if out of specification.



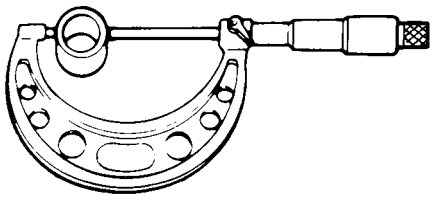
S6AL5470

NOTE:
When measuring the piston pin boss bore, do not measure it at the oil grooves ⓐ or ring groove ⓑ.

Piston pin boss bore:
21.017–21.031 mm
(0.8274–0.8280 in)

Checking the piston pin

1. Measure the piston pin outside diameter. Replace the piston pin if out of specification.

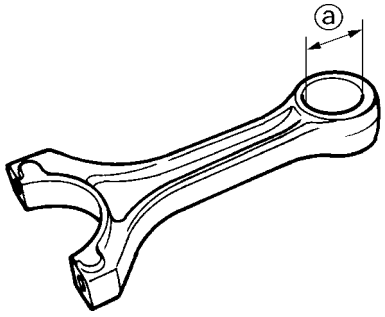


S69J5C30

Piston pin outside diameter:
20.995–21.000 mm
(0.8266–0.8268 in)

Checking the connecting rod small end inside diameter

1. Measure the connecting rod small end inside diameter ⓐ. Replace the connecting rod assembly if out of specification.

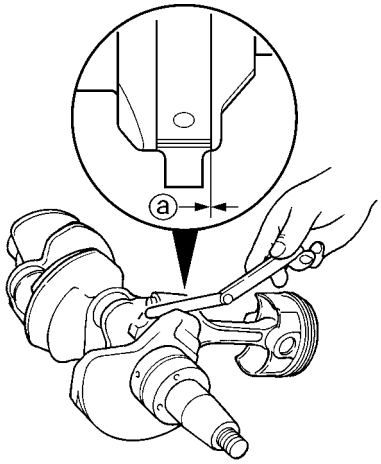


S6AL5790

Connecting rod small end inside diameter ⓐ:
21.017–21.031 mm
(0.8274–0.8280 in)

Checking the connecting rod big end side clearance

1. Measure the connecting rod big end side clearance ⓐ.



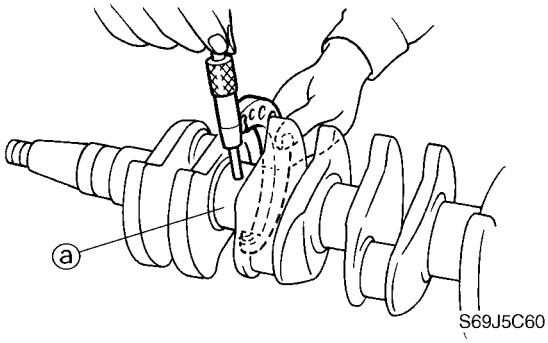
S69J5C50

Connecting rod big end side clearance ⓐ (reference data):
0.15–0.30 mm (0.006–0.012 in)

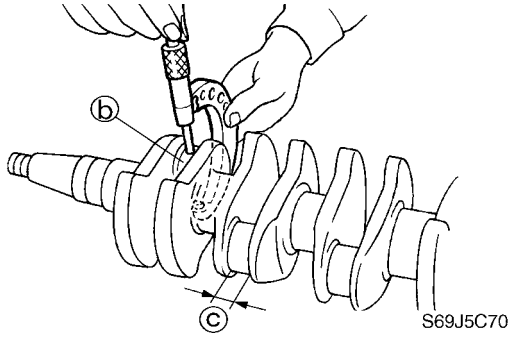
5

Checking the crankshaft

1. Measure the crankshaft journal diameter ⓐ, crankpin diameter ⓑ, and crankpin width ⓒ. Replace the crankshaft if out of specification.



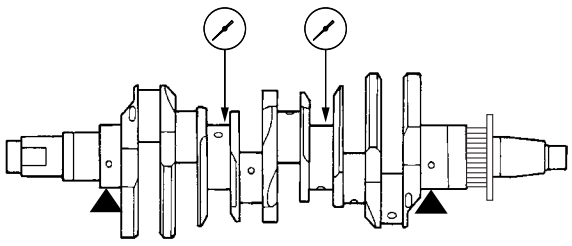
S69J5C60



S69J5C70

Crankshaft journal diameter ⓐ:
62.968–62.992 mm
(2.4791–2.4800 in)
Crankpin diameter ⓑ:
49.976–50.000 mm
(1.9676–1.9685 in)
Crankpin width ⓒ:
21.50–21.55 mm
(0.8465–0.8484 in)

2. Measure the crankshaft runout. Replace the crankshaft if above specification.

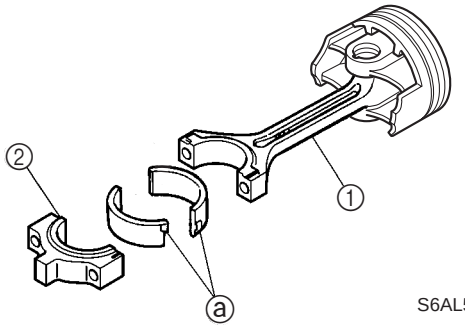

S6AL5480

Crankshaft runout limit:
0.03 mm (0.0012 in)

Checking the crankpin oil clearance

1. Clean the bearings and the connecting rod.

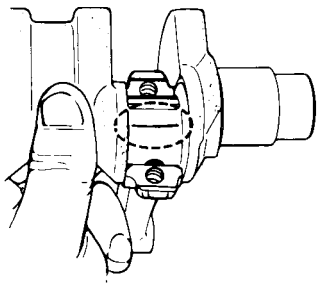
2. Install the upper bearing into the connecting rod ① and the lower bearing into the connecting rod cap ②.



S6AL5B10

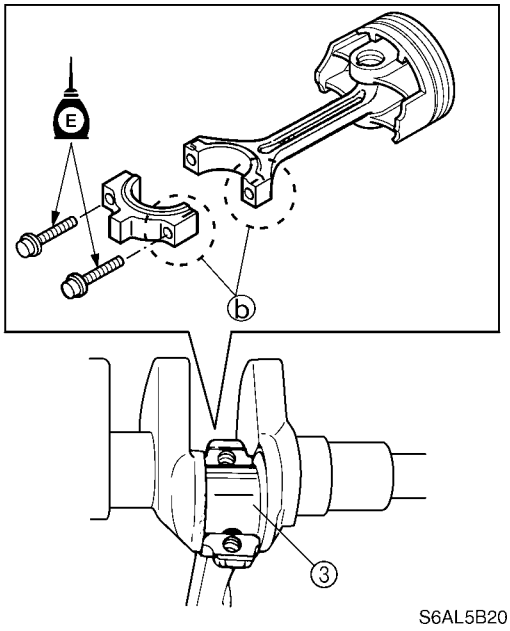
NOTE:
- Install the connecting rod bearings in their original positions.
- Insert the projection ⓐ of each bearing into the slots in the connecting rod cap and connecting rod.

3. Put a piece of Plastigauge (PG-1) onto the crankpin, parallel to the crankshaft.


S69J5D00

NOTE:
Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

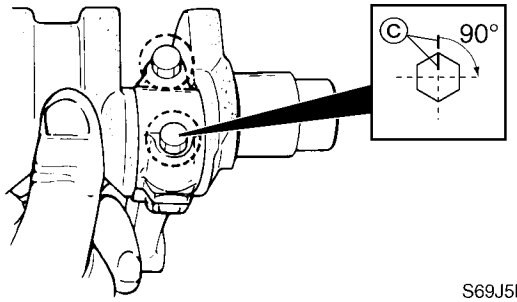
4. Install the connecting rod onto the crankpin ③.



S6AL5B20

NOTE:
Make sure that the marks ⓑ of the connecting rod face toward the flywheel magnet end of the crankshaft.

5. Tighten the connecting rod cap bolts to the specified torques in 3 stages.

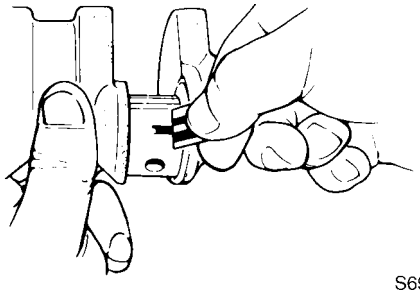


S69J5D20

NOTE:
- Reuse the removed connecting rod cap bolts when checking the oil clearance.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.
- In the 3rd stage, make a mark ⓒ on the connecting rod cap bolts and connecting rod caps, and then tighten the bolts 90° from the mark.

Connecting rod cap bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

6. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.


S69J5D30

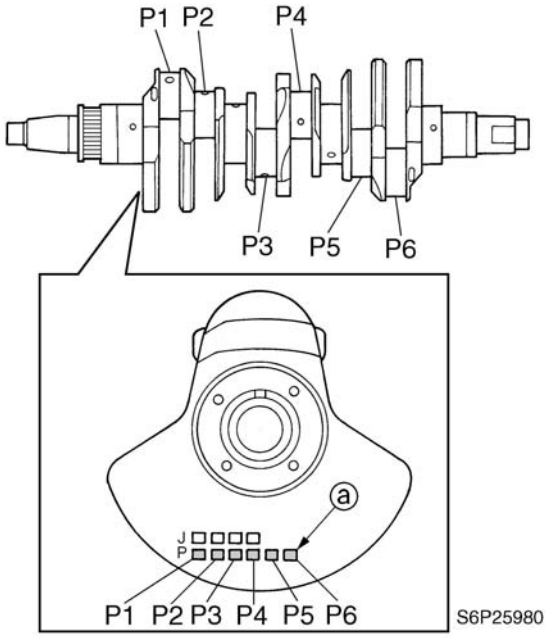
Crankpin oil clearance:
0.028–0.066 mm
(0.0011–0.0026 in)

Selecting the connecting rod bearing

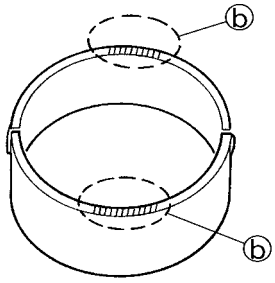
1. When replacing the connecting rod bearing, select the suitable bearing as follows.

5

2. Check the crankpin mark ⓐ on the crankshaft.



3. Select the suitable color ⓑ for the connecting rod bearing from the table.



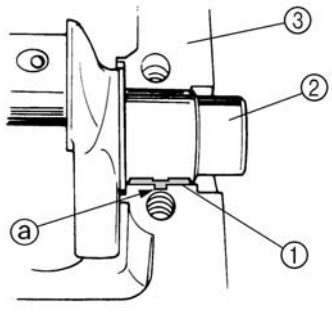
Crankpin mark ⓐ	Bearing color ⓑ
92–00	Yellow
84–91	Green
76–83	Blue

Checking the crankshaft journal oil clearance

1. Clean the bearings, crankshaft journals, and bearing portions of the crankcase and cylinder block.

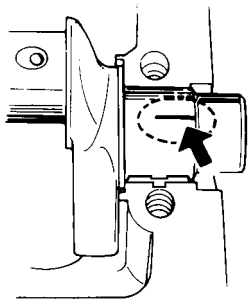
2. Place the cylinder block upside down on a bench.

3. Install half of the main bearings ① and the crankshaft ② into the cylinder block ③.



NOTE:
- Install the bearings in their original positions.
- Insert the projection ⓐ of each bearing into the slots in the cylinder block.

4. Put a piece of Plastigauge (PG-1) on each crankshaft journal parallel to the crankshaft.



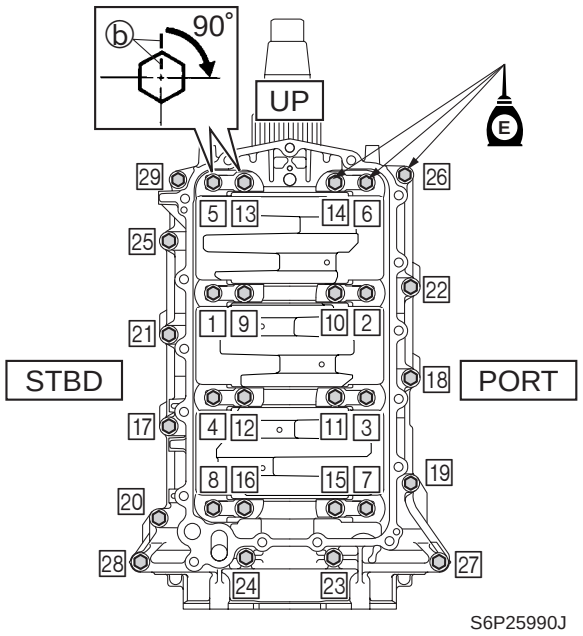
NOTE:
Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

5. Install the remaining half of the main bearings into the crankcase.

NOTE:
- Install the bearings in their original positions.
- Insert the projection ⓐ of each bearing into the slots in the crankcase.

6. Install the crankcase onto the cylinder block and apply engine oil to the threads of the crankcase bolts.

7. Tighten the crankcase bolts to the specified torques in 2 stages and in the sequence shown.

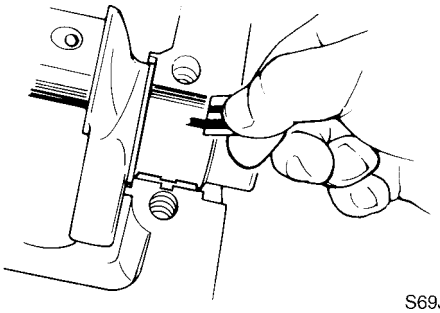


S6P25990J

NOTE:
- Crankcase bolts 1–16 can be reused 5 times.
- Do not turn the crankshaft until the crankshaft journal oil clearance measurement has been completed.
- Tighten the M8 bolts 1–8 and M10 bolts 9–16 to the specified torques in 2 stages. In the 2nd stage, make a mark ⓑ on the crankcase and crankcase bolts, and then tighten crankcase bolts 1–16 90° from the mark.
- After tightening the bolts 1–16 has been completed, tighten the M8 bolts 17–29 to the specified torques in 2 stages.

Crankcase bolt 1–8 (M8):
1st: 25 N·m (2.5 kgf·m, 18.4 ft·lb)
2nd: 90°
Crankcase bolt 9–16 (M10):
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°
Crankcase bolt 17–29 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

8. Gently remove the crankcase, and then measure the width of the compressed Plastigauge (PG-1) on each crankshaft journal. Replace the main bearing if out of specification.


S69J5D90

NOTE:
When loosening the crankcase bolts, loosen them in the opposite order used for tightening.

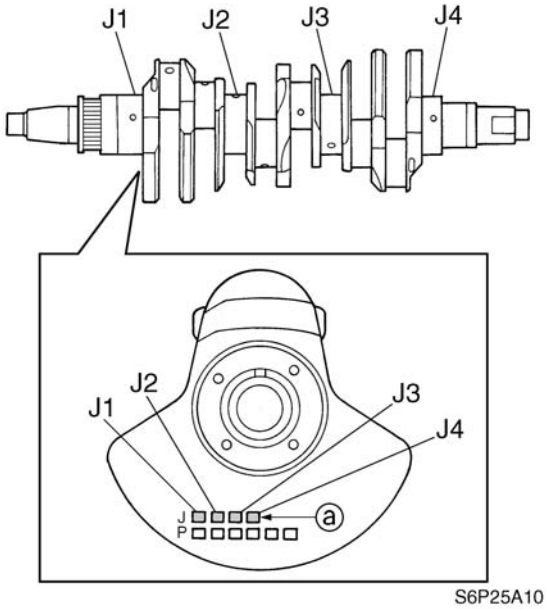
Crankshaft journal oil clearance:
0.025–0.050 mm
(0.0010–0.0020 in)

Selecting the main bearing

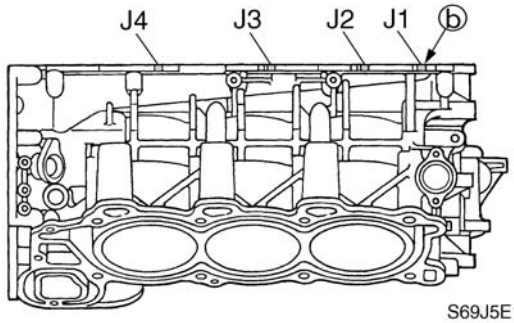
1. When replacing the main bearing, select the suitable bearing as follows.

5

2. Check the crankshaft journal mark ⓐ on the crankshaft and the cylinder block mark ⓑ on the cylinder block.

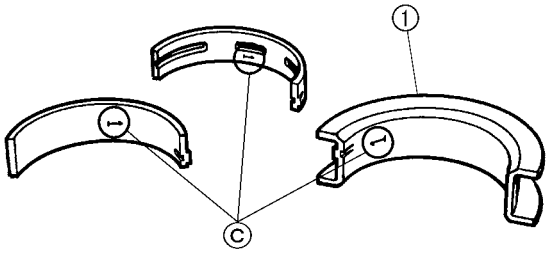


S6P25A10



S69J5E10

3. Select the suitable main bearing number ⓒ from the table.



S6P25D30

Crankshaft journal mark ⓐ \ Cylinder block mark ⓑ	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
92	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
91	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
89	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
88	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
87	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
86	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
85	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3
84	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3
83	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
82	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
81	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
80	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
79	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
78	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
77	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
76	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
75	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
74	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
73	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
72	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
71	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
70	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
69	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
68	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

NOTE:

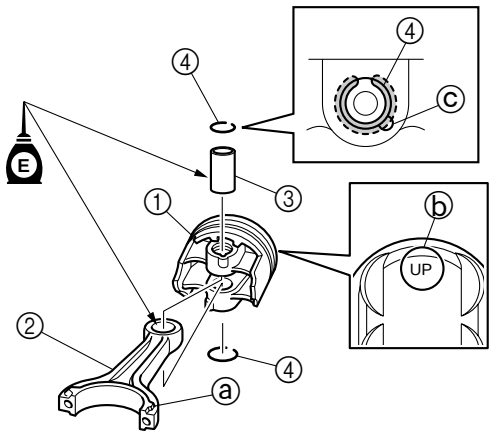
- Example: If the crankshaft journal mark ⓐ is “81” and the cylinder block mark ⓑ is “04,” then the main bearing number ⓒ is “1.”
- Lower main bearing for J3 is a thrust bearing ①.

Assembling the power unit

NOTE:

See the exploded diagram (5-59).

1. Assemble the piston ①, connecting rod ②, piston pin ③, and new piston pin clips ④.



S6AL5490

CAUTION:

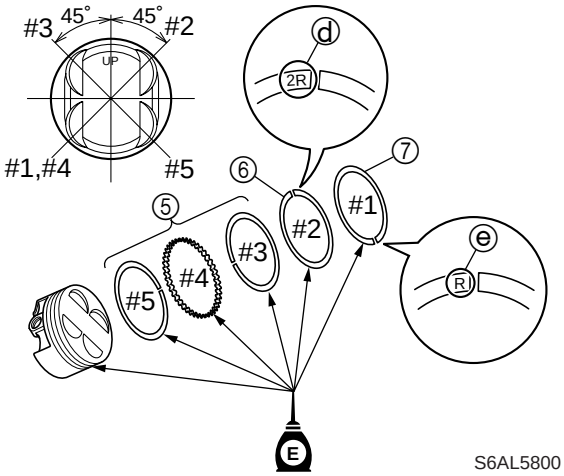
Do not reuse the piston pin clips ④, always replace them with new ones.

NOTE:

- If a connecting rod is reused, face the mark ⓐ on the connecting rod in the same direction as the "UP" mark ⓑ on the piston.
- If a new connecting rod is installed, it can be installed with either side facing up.
- Do not allow the piston pin clip end to align with the piston pin slot ⓒ.

2. Install the oil rings ⑤, second ring ⑥, and top ring ⑦ to the piston with the "2R" mark ⓓ of the second ring and the "R" mark ⓔ of the top ring facing upward.

3. Offset the piston ring end gaps as shown.



S6AL5800

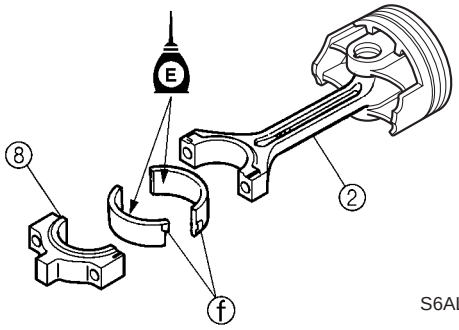
CAUTION:

Do not scratch the pistons or break the piston rings.

NOTE:

After installing the piston rings, check that they move smoothly.

4. Install the upper bearing into the connecting rod ② and the lower bearing into the connecting rod cap ⑧.

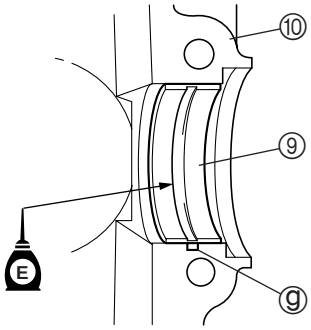


S6AL5810

NOTE:

- Install the connecting rod bearings in their original positions.
- Insert the projections ⓕ of the bearings into the slots on the connecting rod cap and connecting rod.

5. Install half of the main bearings ⑨ into the cylinder block ⑩.



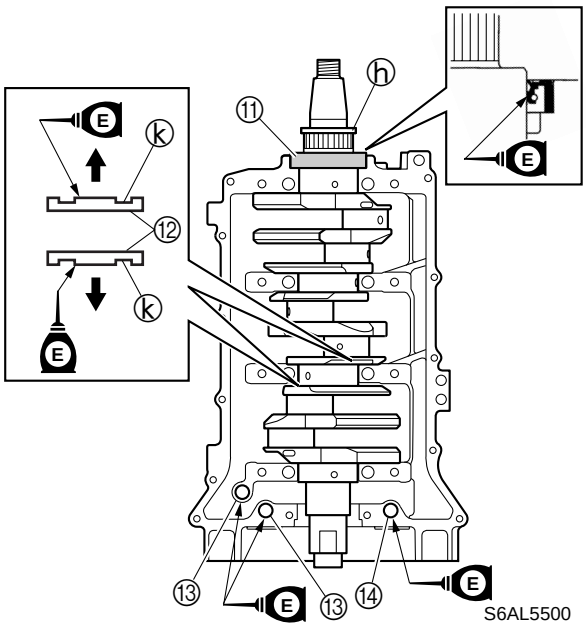
S6AL5820

NOTE:

- Install the bearings in their original positions.
- Insert the projection ⓖ of each bearing into the slots in the cylinder block.

5

6. Set the crankshaft, new oil seal ⑪ and thrust bearings ⑫, and new O-rings ⑬ and ⑭ into the cylinder block as shown.



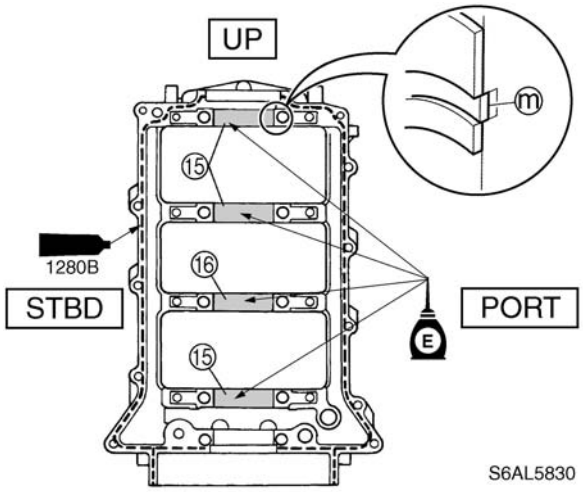
CAUTION:

Do not damage the oil seal when installing it by contacting the edge ⓗ of the drive sprocket.

NOTE:
- Apply engine oil to the oil seal lip ⑪, thrust bearings ⑫ and the O-rings ⑬ and ⑭ before installation.
- Do not get any engine oil to the drive sprocket.
- Install each thrust bearing with its grooves ⓚ facing outward as shown.

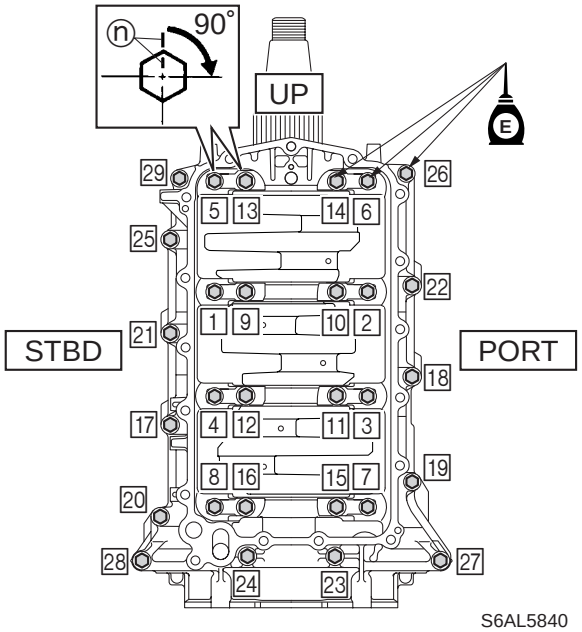
7. Install half of the main bearings ⑮ and the thrust bearing ⑯ into the crankcase.

8. Apply sealant to the mating surface of the crankcase.



NOTE:
- Install the main bearings in their original positions.
- Insert the projection ⓜ of each bearing into the slots in the crankcase.
- Do not get any sealant on the main bearings.

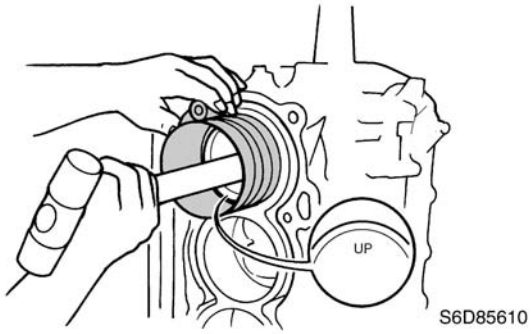
9. Install the crankcase onto the cylinder block, and then tighten the crankcase bolts to the specified torques in 2 stages and in the sequence shown.



NOTE:
- Crankcase bolts 1–16 can be reused 5 times.
- The oil seal ⑪ must be installed before tightening the crankcase bolts.
- Apply engine oil to the crankcase bolts before installation.
- Tighten the M8 bolts 1–8 and M10 bolts 9–16 to the specified torques in 2 stages. In the 2nd stage, make a mark ⓝ on the crankcase and crankcase bolts, and then tighten crankcase bolts 1–16 90° from the mark.
- After tightening the bolts 1–16 has been completed, tighten the M8 bolts 17–29 to the specified torques in 2 stages.
- After tightening the crankcase bolts, check that the crankshaft rotates smoothly.

Crankcase bolt 1–8 (M8):
1st: 25 N·m (2.5 kgf·m, 18.4 ft·lb)
2nd: 90°
Crankcase bolt 9–16 (M10):
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°
Crankcase bolt 17–29 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

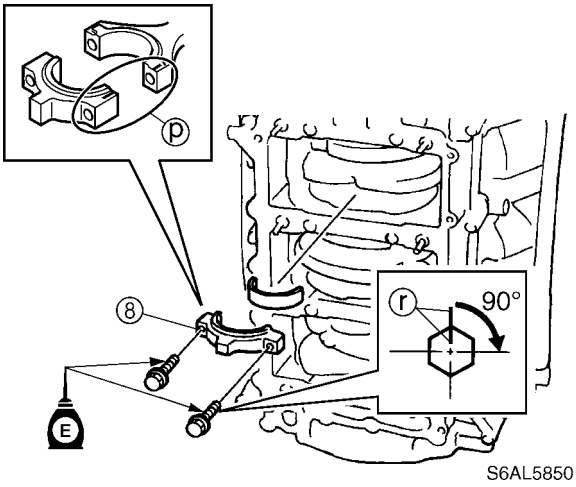
10. Install the piston with the “UP” mark on the piston crown facing towards the flywheel magnet.



NOTE:
Apply engine oil to the side of the pistons and piston rings before installation.

Piston ring compressor:
90890-05158

11. Install the connecting rod cap ⑧ to the connecting rod, and then tighten new connecting rod cap bolts to the specified torques in 3 stages.



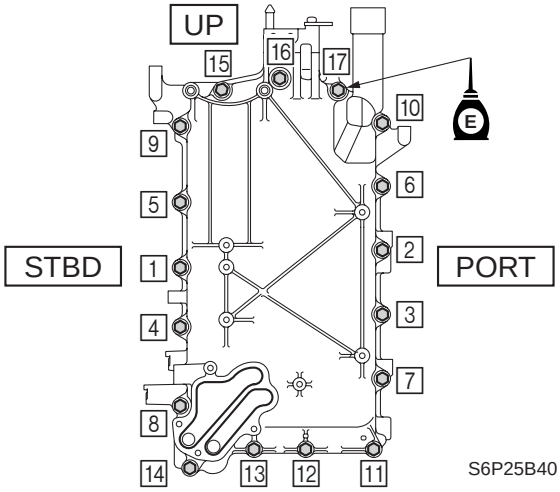
CAUTION:
Do not reuse the connecting rod cap bolts, always replace them with new ones.

NOTE:
- Align the marks ⓟ on the connecting rod cap and connecting rod.
- Apply engine oil to the connecting rod caps and connecting rod cap bolts before installation.
- In the 3rd stage, make a mark ⓡ on the connecting rod cap bolts and connecting rod caps, and then tighten the bolts 90° from the mark.
- After tightening the connecting rod cap bolts, check that the crankshaft rotates smoothly.

Connecting rod cap bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

5

12. Install a new gasket and the crankcase cover, and then tighten the bolts to the specified torques in 2 stages and in the sequence shown.



CAUTION:

Do not reuse the gasket, always replace them with new ones.

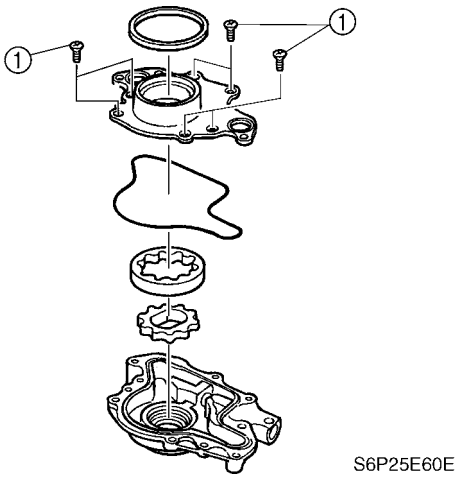
NOTE:

- Apply engine oil to the crankcase bolts before installation.
- Tighten the crankcase bolts 1–17 to the specified torques in 2 stages.

Crankcase cover bolt 1–17:
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

Disassembling the oil pump

1. Remove the screws ① and disassemble the oil pump.



NOTE:

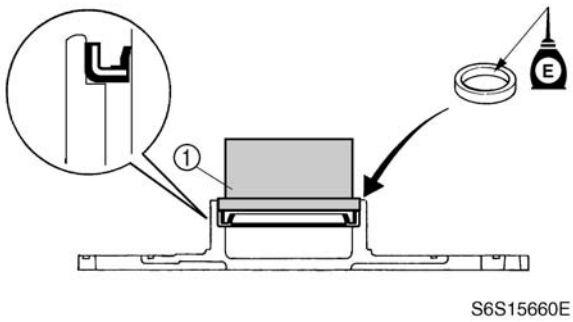
See the exploded diagram (5-59).

Checking the oil pump

1. Check the gear teeth and inner surface of the oil pump case. Replace the oil pump assembly if the gear teeth are cracked or worn, or if inner surface of the oil pump case is scratched.

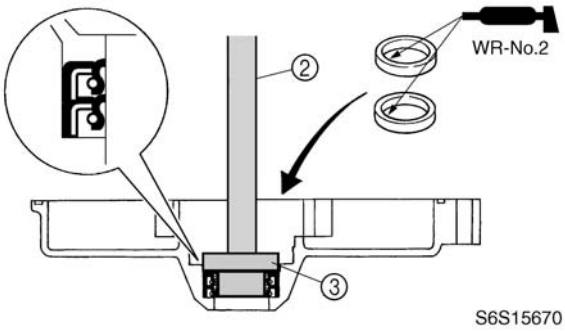
Assembling the oil pump

1. Install a new oil seal into the oil pump cover.



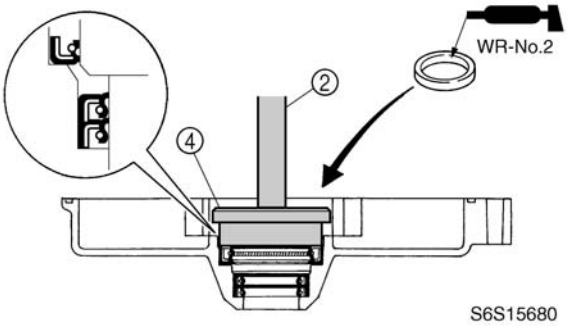
Bearing inner race attachment ①:
90890-06661

2. Install new oil seals into the oil pump housing.



Driver rod L3 ②: 90890-06652
Needle bearing attachment ③:
90890-06613

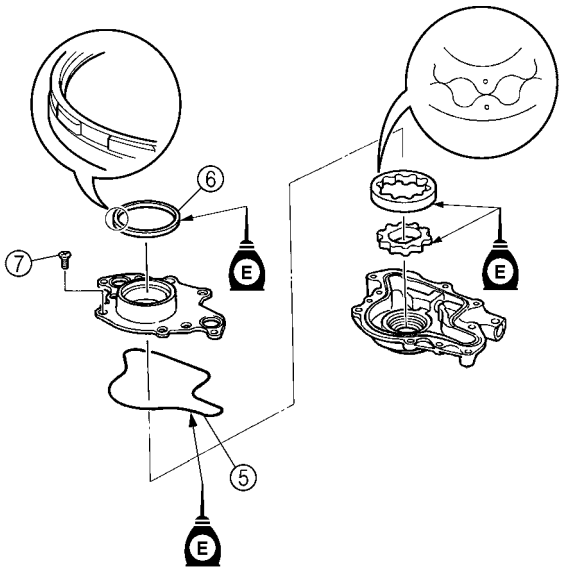
3. Install a new oil seal into the oil pump housing.



Driver rod L3 ②: 90890-06652
Needle bearing attachment ④:
90890-06607

4. Install a new gasket ⑤, and then tighten the screws ⑦ to the specified torque.

5. Install a new oil seal ⑥ into the oil pump, making sure to install it in the proper direction.

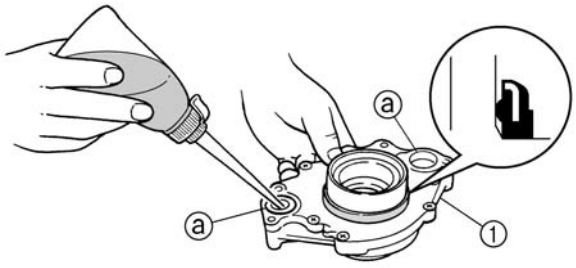


Oil pump cover screw ⑦:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

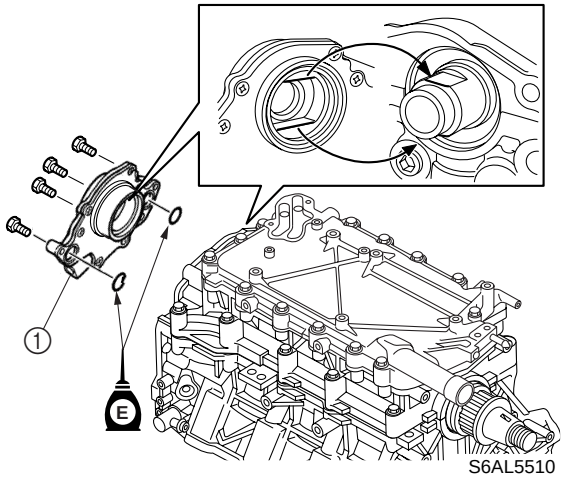
5

Installing the oil pump

1. Install the oil pump ① by aligning the oil pump gear with the crankshaft.



S6AL5860



S6AL5510

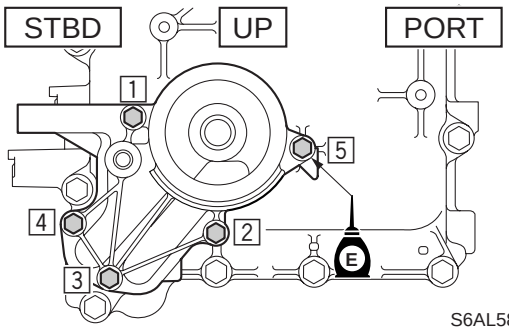
CAUTION:

Before installing the oil pump, be sure to fill it with engine oil through the oil passage ⓐ.

NOTE:

When installing the oil pump, install it so that the oil seal does not get damaged.

2. Install a new gasket and the oil filter bracket, and then tighten the bolts in the sequence shown.

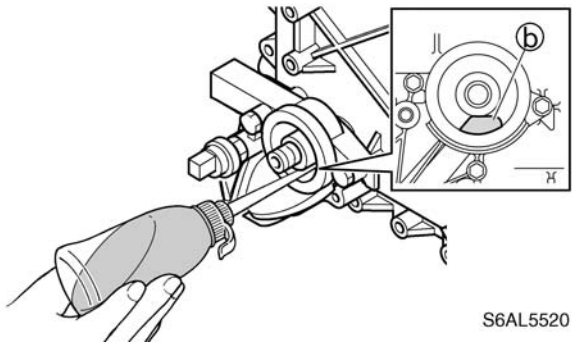


S6AL5870

NOTE:

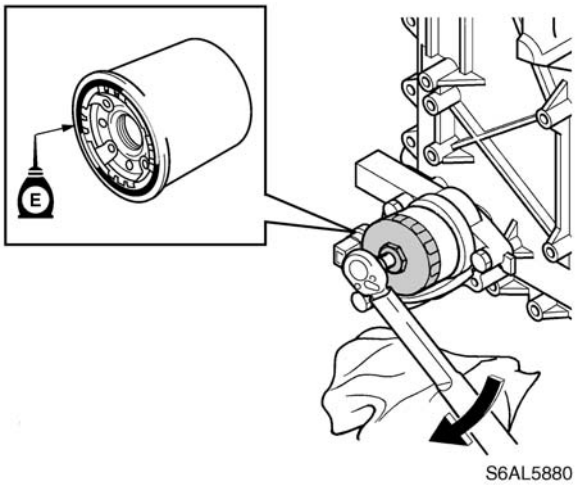
Apply engine oil to the oil filter bracket bolts before installation.

3. Supply engine oil to the oil passage ⓑ of the oil filter bracket.



S6AL5520

4. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



S6AL5880

NOTE:

Apply a thin coat of engine oil to the O-ring of a new oil filter before installation.

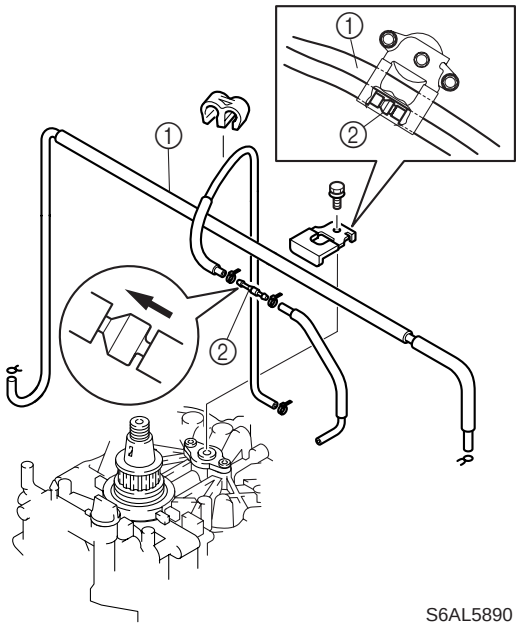
	Oil filter wrench: 90890-06830

	Oil filter: 18 N·m (1.8 kgf·m, 13.3 ft·lb)

Installing the wiring harness

NOTE:
- To install all of the wiring harnesses, see Chapter 8, “Wiring harness routing.”
- Perform this procedure after assembling the power unit.

1. Fasten the cooling water hose ①, vapor gas hoses, and check valve ② using the holder as shown.



S6AL5890

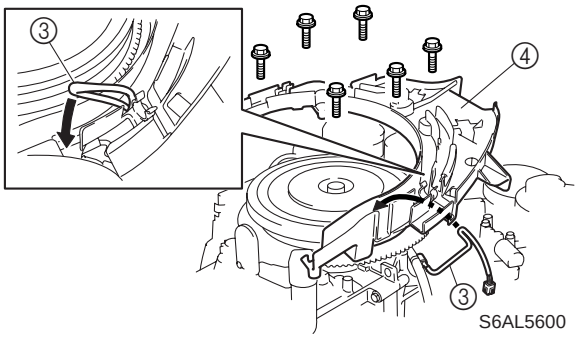
2. Install the cooling water passage cover and cylinder heads.

NOTE:
To install the cooling water passage cover and cylinder heads, see Chapter 5, “Installing the cooling water passage cover” and “Installing the cylinder head.”

3. Install the sensors and switches that were removed to the power unit.

NOTE:
For the location of the sensors and switches, see Chapter 8, “Electrical component.”

4. Install the engine temperature sensor lead ③ into the slit in the wiring harness guide ④, and then install the wiring harness guide onto the power unit.



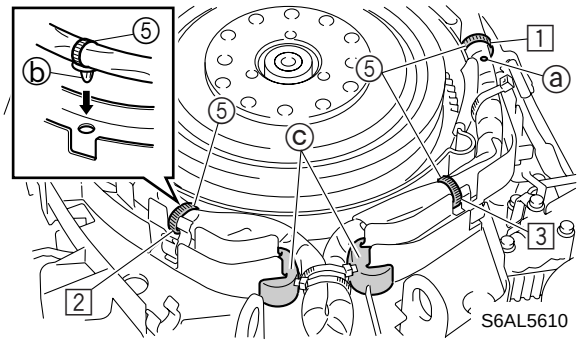
S6AL5600

NOTE:
It is recommended to check the crank position sensor air gap before installing the wiring harness guide to improve working efficiency. To check the crank position sensor air gap, see Chapter 8, “Checking the crank position sensor air gap.”

5

5. Install the wiring harness onto the wiring harness guide with the mark ⓐ facing upward, and then insert the projections ⓑ on the plastic ties ⑤ into the holes in the wiring harness guide in the sequence shown.

6. Fasten the wiring harness using the plastic ties.



S6AL5610

NOTE:
- Be sure to install the wiring harness onto the wiring harness guide so that the wiring harness does not protrude above the top edge of the wiring harness guide.
- Be sure to install the wiring harness between the swells ⓒ.

7. Install the sub wiring harness, fuse box, PTT relay, and Rectifier Regulator to the junction box.

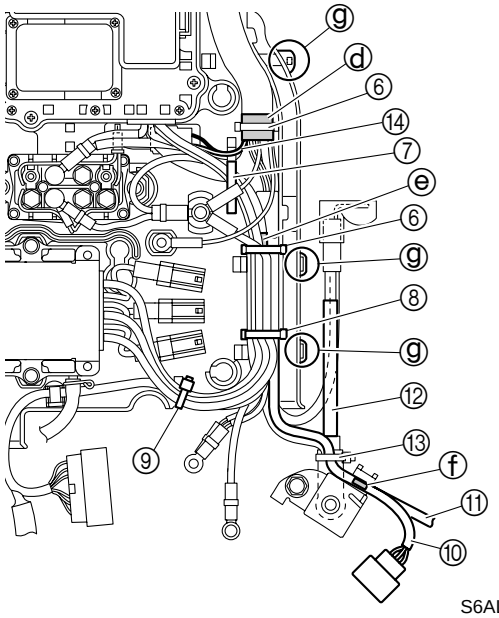
NOTE:
To install the sub wiring harness, fuse box, PTT relay, and Rectifier Regulator to the junction box, see the exploded diagram (5-37, 5-36).

8. Install the junction box onto the power unit, and then tighten the bolts temporarily.

9. Install the wiring harness to the junction box, and then fasten the wiring harness at the white tape ⓓ and the sub wiring harness at the white tape ⓔ using the plastic ties ⑥.

10. Install the plastic ties ⑦, ⑧, and ⑨.

11. Fasten the oil pressure sensor lead ⑩, isolator lead ⑪, and positive terminal lead ⑫ with its cap using the plastic tie ⑬, making sure to align the white tape ⓕ on the oil pressure sensor lead ⑩ with the guide of the positive battery terminal.

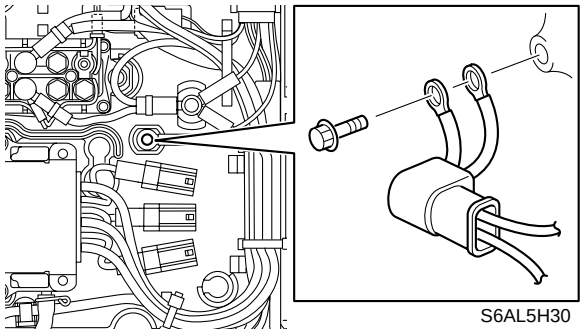


S6AL5590

NOTE:
- Do not fasten the PTT relay lead ⑭ with the plastic tie ⑦.
- It is recommended to temporarily install the plastic ties to the sections ⓖ of the junction box to improve working efficiency.

12. Tighten the junction box bolts completely.

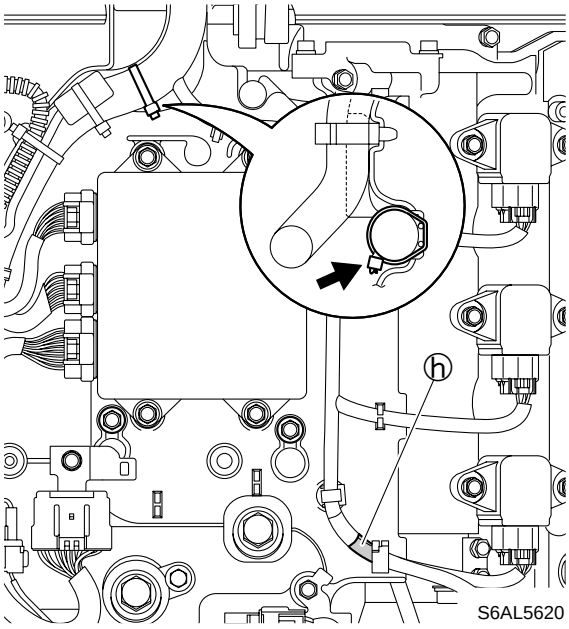
13. Install the terminals of the starter motor lead (brown/white) and the wiring harness lead (brown) using the same bolt.


S6AL5H30

CAUTION:

Do not bend the terminals of the starter motor leads when installing them.

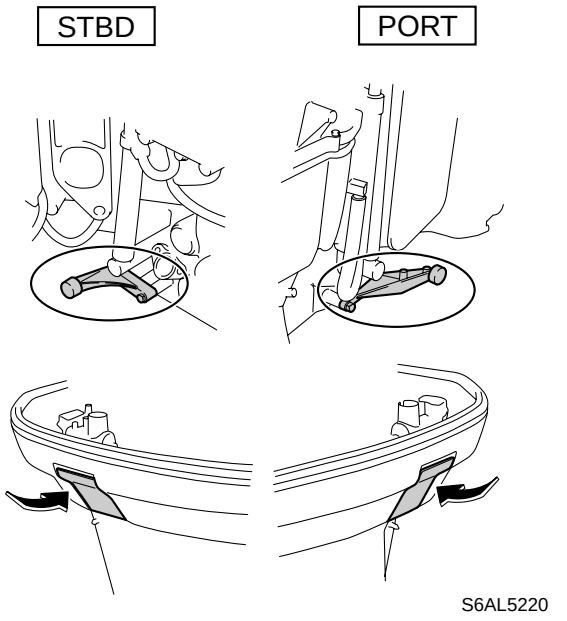
14. Install the wiring harness onto the ECM bracket, and then fasten it at the white tape ⓗ.



15. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

Installing the power unit

1. Retract the port and starboard top cowling lock levers.



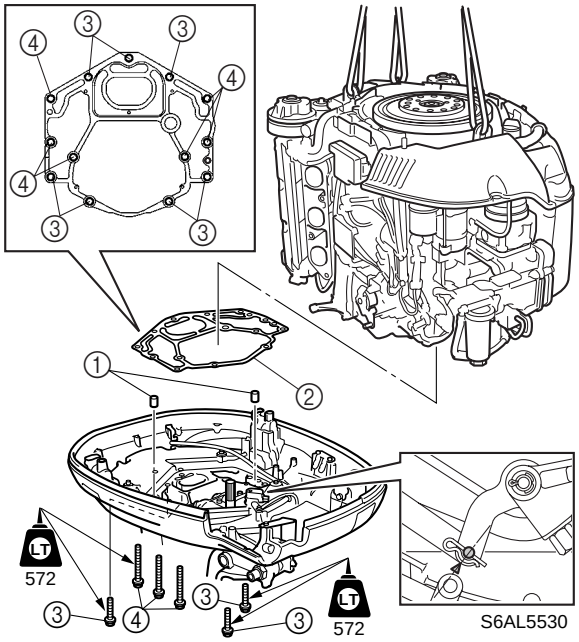
CAUTION:

Make sure that the top cowling lock levers are retracted and the engine stoppers are installed before installing the power unit, otherwise the fuel rails could be damaged.

5

2. Clean the power unit mating surface, and install the dowels ① and a new gasket ②.

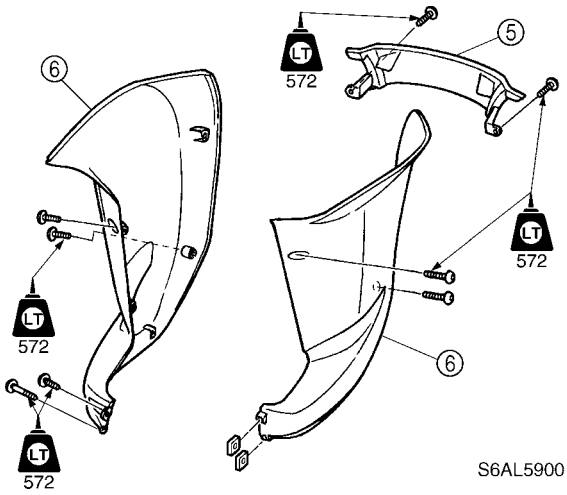
3. Install the power unit by installing the bolts ③ and ④, and then tightening them to the specified torque.



NOTE:
Be sure to install the shift rod assembly onto the bottom cowling before installing the power unit.

Power unit mounting bolt ③ and ④:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

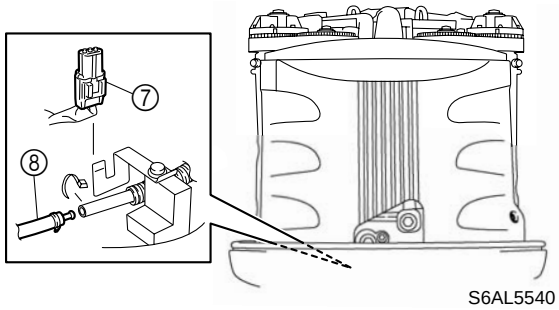
4. Install the upper case cover ⑤ and aprons ⑥.



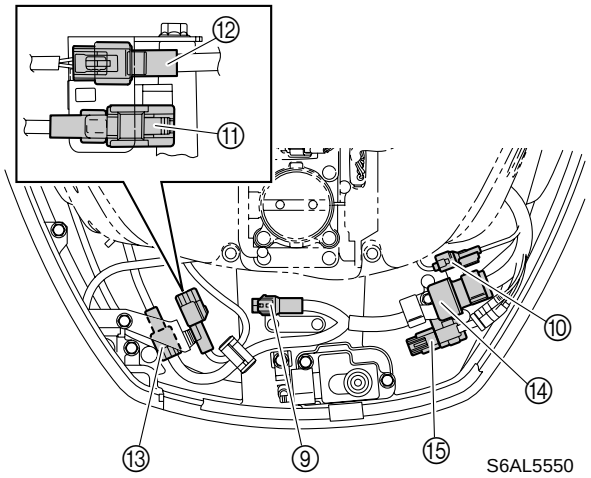
Apron bolt and upper case cover bolt:
8 N·m (0.8 kgf·m, 5.9 ft·lb)

5. Install the speed sensor coupler ⑦ to the bracket.

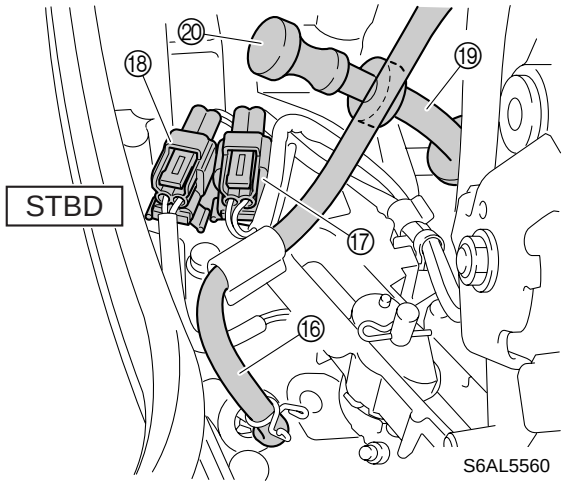
6. Connect the flushing hose ⑧.



7. Connect the warning indicator coupler ⑨, trim sensor coupler ⑩, isolator coupler ⑪, water detection switch coupler (blue) ⑫, PTT switch coupler ⑬, 10-pin main harness coupler ⑭, LAN communication coupler (white) ⑮, and then install them onto the brackets.

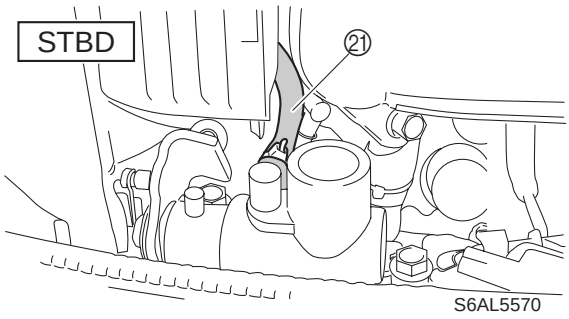


8. Connect the cooling water pilot hose ⑯.
9. Connect the neutral switch coupler (blue) ⑰ and shift cut switch coupler ⑱, and then install them onto the bracket.
10. Install the dipstick guide ⑲ and oil dipstick ⑳.

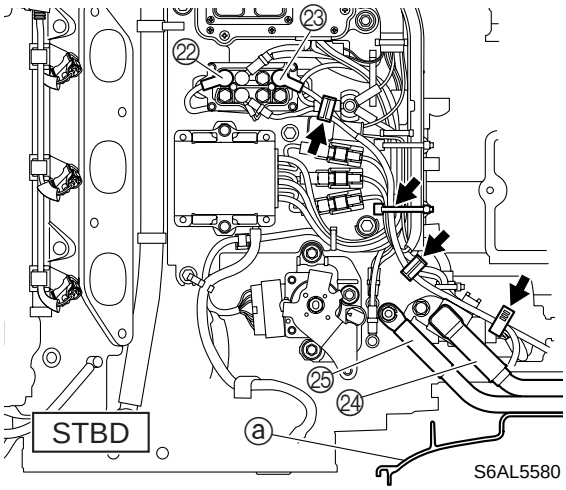


NOTE:
Apply engine oil to the O-ring before installing the dipstick guide.

11. Connect the vapor gas hose ㉑ to the starboard top cowling lock.



12. Connect the PTT motor leads ㉒ (blue) and ㉓ (light green), and then fasten them.
13. Route the positive battery cable ㉔ and negative battery cable ㉕ along the bottom of the bottom cowling ⓐ, and then connect them.



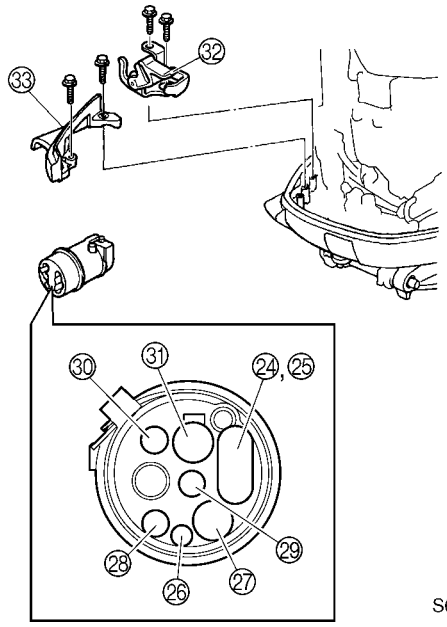
NOTE:
To wire the PTT motor leads and battery cables, see Chapter 8, “Wiring harness routing.”

	PTT motor lead bolt: 4 N·m (0.4 kgf·m, 3.0 ft·lb) Positive battery cable bolt: 18 N·m (1.8 kgf·m, 13.3 ft·lb) Negative battery cable nut: 13 N·m (1.3 kgf·m, 9.6 ft·lb)

14. Connect the fuel hose.

15. Install the grommet with the speedometer hose ㉖, fuel hose ㉗, positive battery cable ㉔, negative battery cable ㉕, shift cable ㉘, gauge harness ㉙, throttle cable ㉚, and 10-pin main harness ㉛.

16. Install the cable holder ㉜ and retaining plate ㉝.



17. Connect the shift cable and throttle cable, and then adjust their lengths.

NOTE:
To adjust the shift cable and throttle cable, see Chapter 3, “Adjusting the throttle cable” and “Checking the gear shift operation.”

18. Install the starboard intake manifold.

NOTE:
To install the intake manifold, see Chapter 4, “Installing the intake manifold.”

19. Install all the parts that were removed.

— MEMO —

Lower unit

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Checking the water pump and shift rod 6-5

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Disassembling the drive shaft housing 6-14
Disassembling the forward gear 6-14
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Lower unit (counter rotation model) 6-31
Removing the lower unit 6-33
Removing the water pump and shift rod 6-33
Checking the water pump and shift rod 6-34

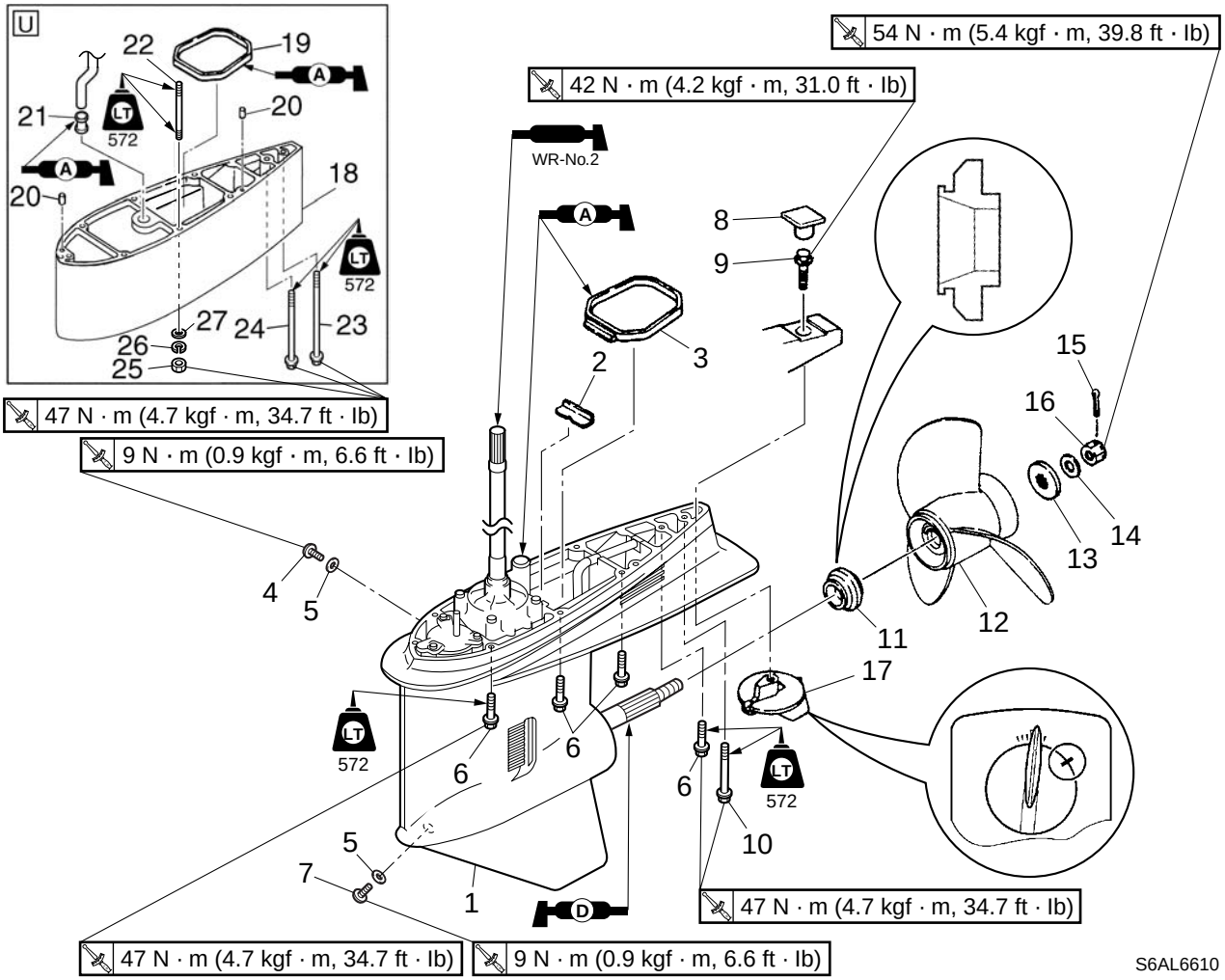
Propeller shaft housing (counter rotation model) 6-35
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Checking the propeller shaft housing 6-38
Checking the propeller shaft 6-39
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Drive shaft and lower case (counter rotation model) 6-42
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Checking the pinion and reverse gear 6-45
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Assembling the drive shaft housing 6-47
Installing the drive shaft 6-47
Installing the propeller shaft housing 6-48
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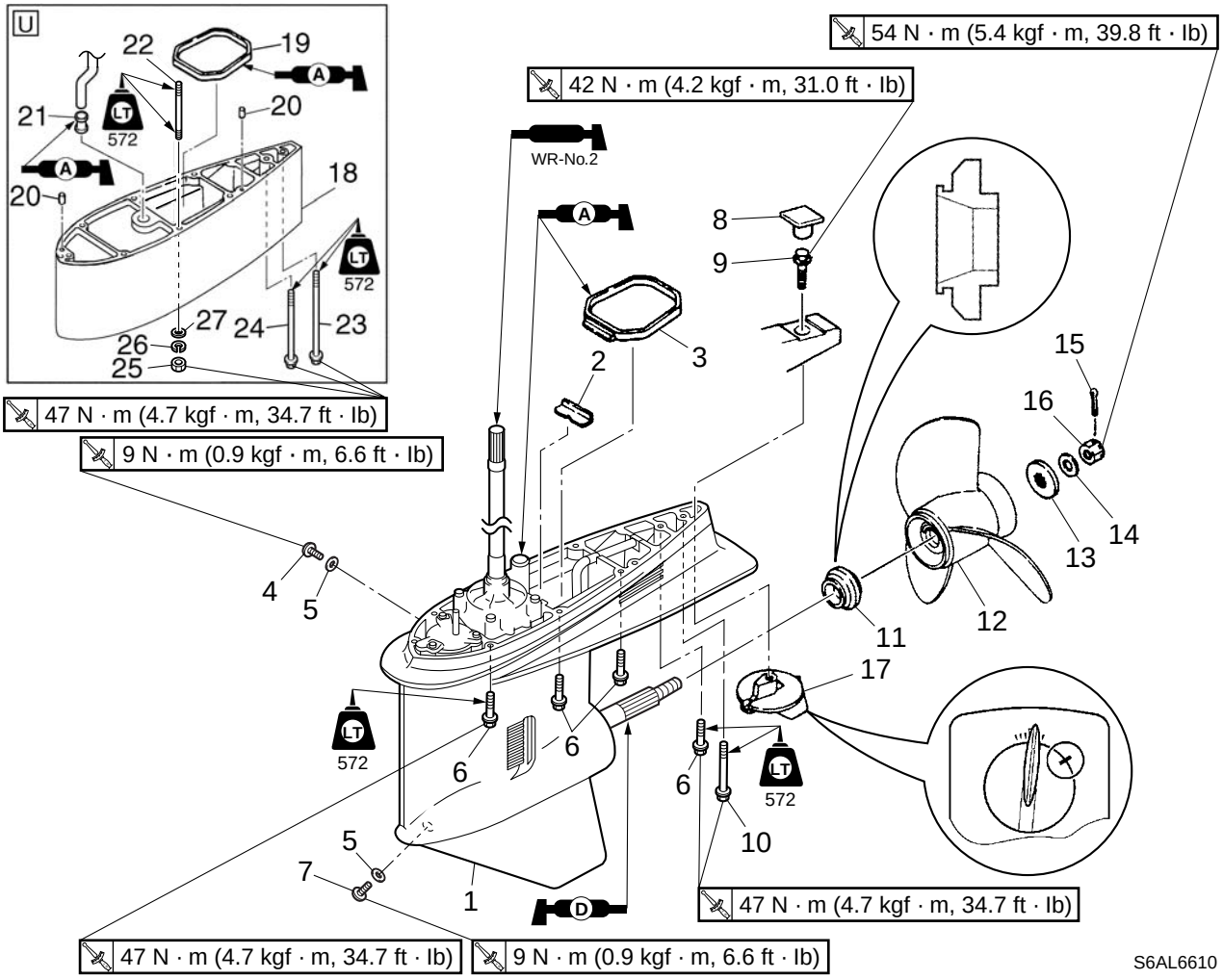
Shimming (counter rotation model) 6-53
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Selecting the propeller shaft shim 6-58

Backlash (counter rotation model) 6-60
Measuring the forward and reverse gear backlash 6-60

Lower unit (regular rotation model)

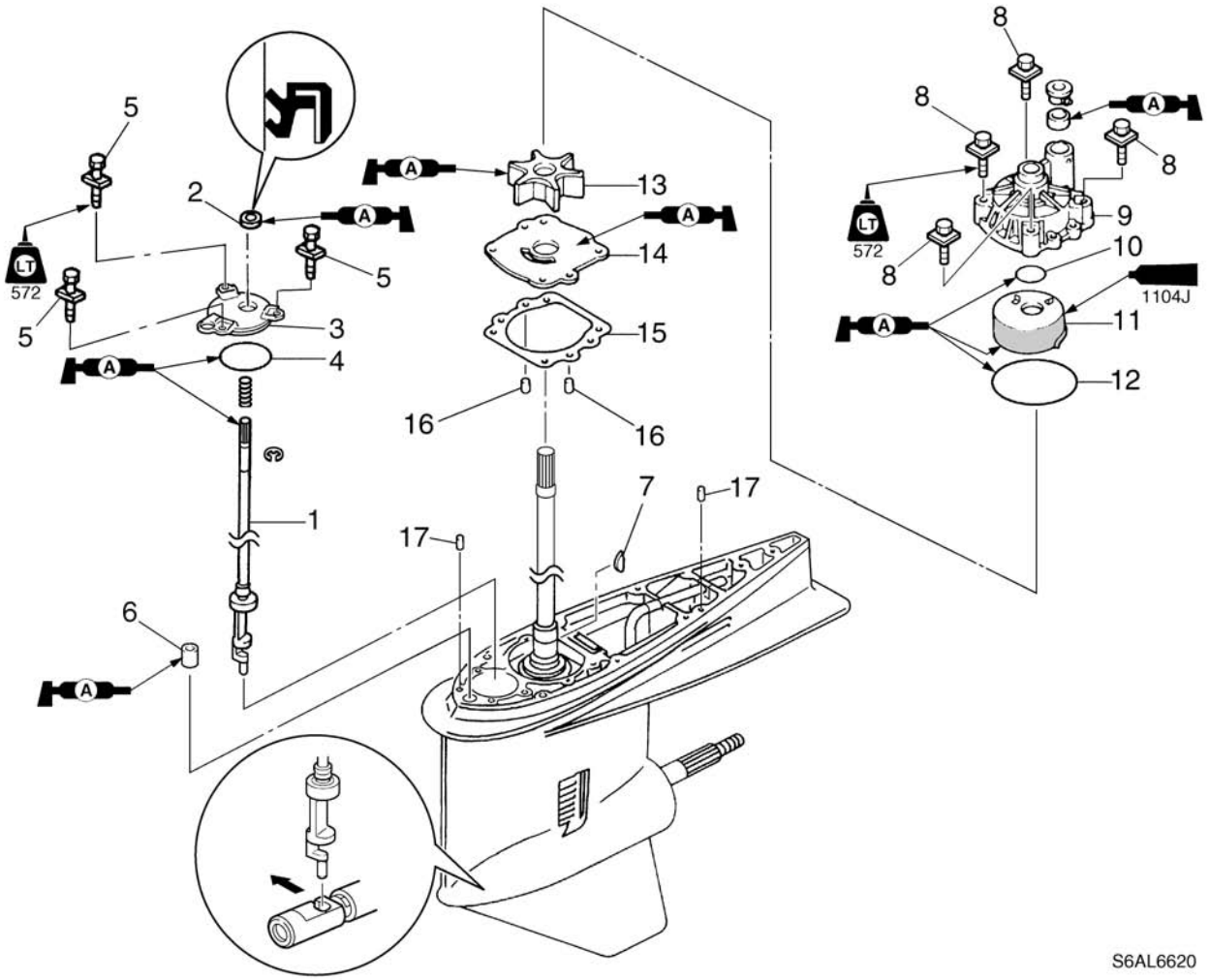


No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	**Not reusable**
6	Bolt	7	M10 × 45 mm/X-transom model
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 45 mm
10	Bolt	1	M10 × 70 mm/X-transom model
11	Spacer	1	
12	Propeller	1	
13	Spacer	1	
14	Washer	1	
15	Cotter pin	1	**Not reusable**
16	Propeller nut	1	
17	Trim tab	1	



No.	Part name	Q'ty	Remarks
18	Extension	1	U-transom model
19	Rubber seal	1	U-transom model
20	Dowel	2	U-transom model
21	Rubber seal	1	U-transom model
22	Stud bolt	6	M10 × 190 mm/U-transom model
23	Bolt	1	M10 × 200 mm/U-transom model
24	Bolt	1	M10 × 174 mm/U-transom model
25	Nut	6	U-transom model
26	Spring washer	6	U-transom model
27	Washer	6	U-transom model

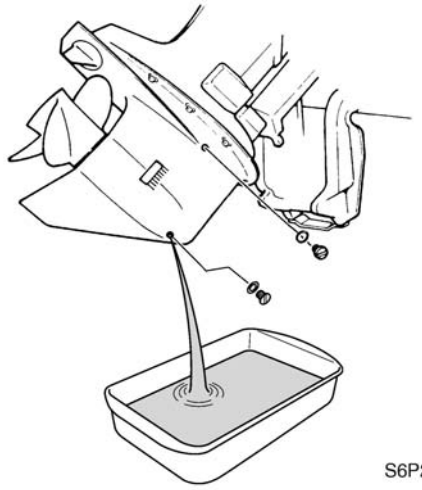
U (U-transom model): F225B regular rotation model only



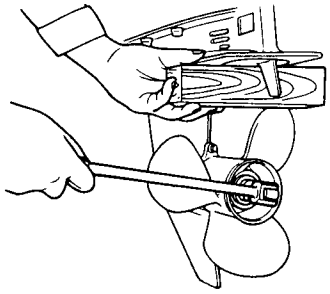
No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	Not reusable
3	Oil seal housing	1	
4	O-ring	1	Not reusable
5	Bolt	3	M6 × 20 mm
6	Seal	1	
7	Woodruff key	1	
8	Bolt	4	M8 × 45 mm
9	Water pump housing	1	
10	O-ring	1	Not reusable
11	Insert cartridge	1	
12	O-ring	1	Not reusable
13	Impeller	1	
14	Outer plate cartridge	1	
15	Gasket	1	Not reusable
16	Dowel	2	
17	Dowel	2	

Removing the lower unit

1. Drain the gear oil.


S6P26400E

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.

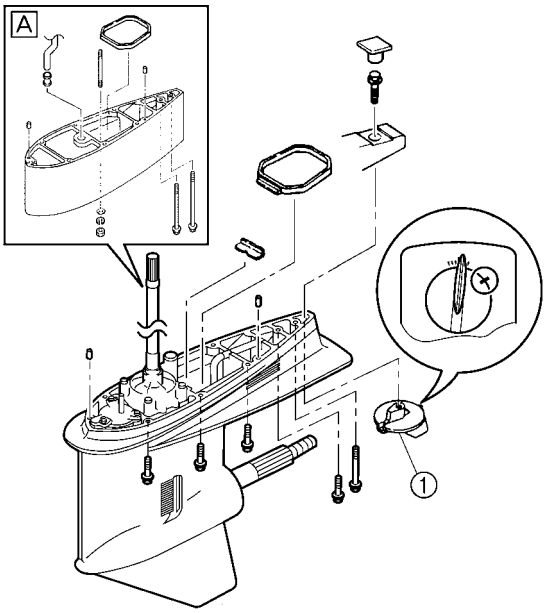

S69J6015

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**
- **When removing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**

3. Mark the trim tab ① at the area shown, and then remove it.

4. Remove the bolts (nuts), and then remove the lower unit from the upper case.



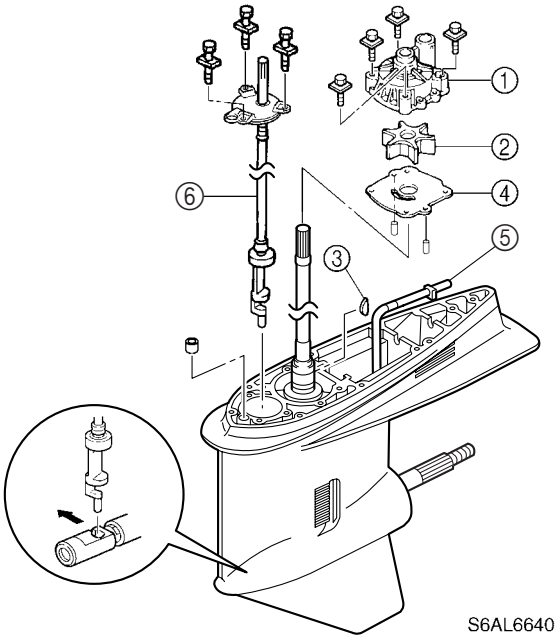
S6AL6630

A U-transom model

6

Removing the water pump and shift rod

1. Remove the water pump housing ① and impeller ②.
2. Remove the Woodruff key ③.
3. Remove the outer plate cartridge ④ and water pipe ⑤.
4. Set the gear shift to the neutral position, and then remove the shift rod assembly ⑥.



Shift rod push arm: 90890-06052

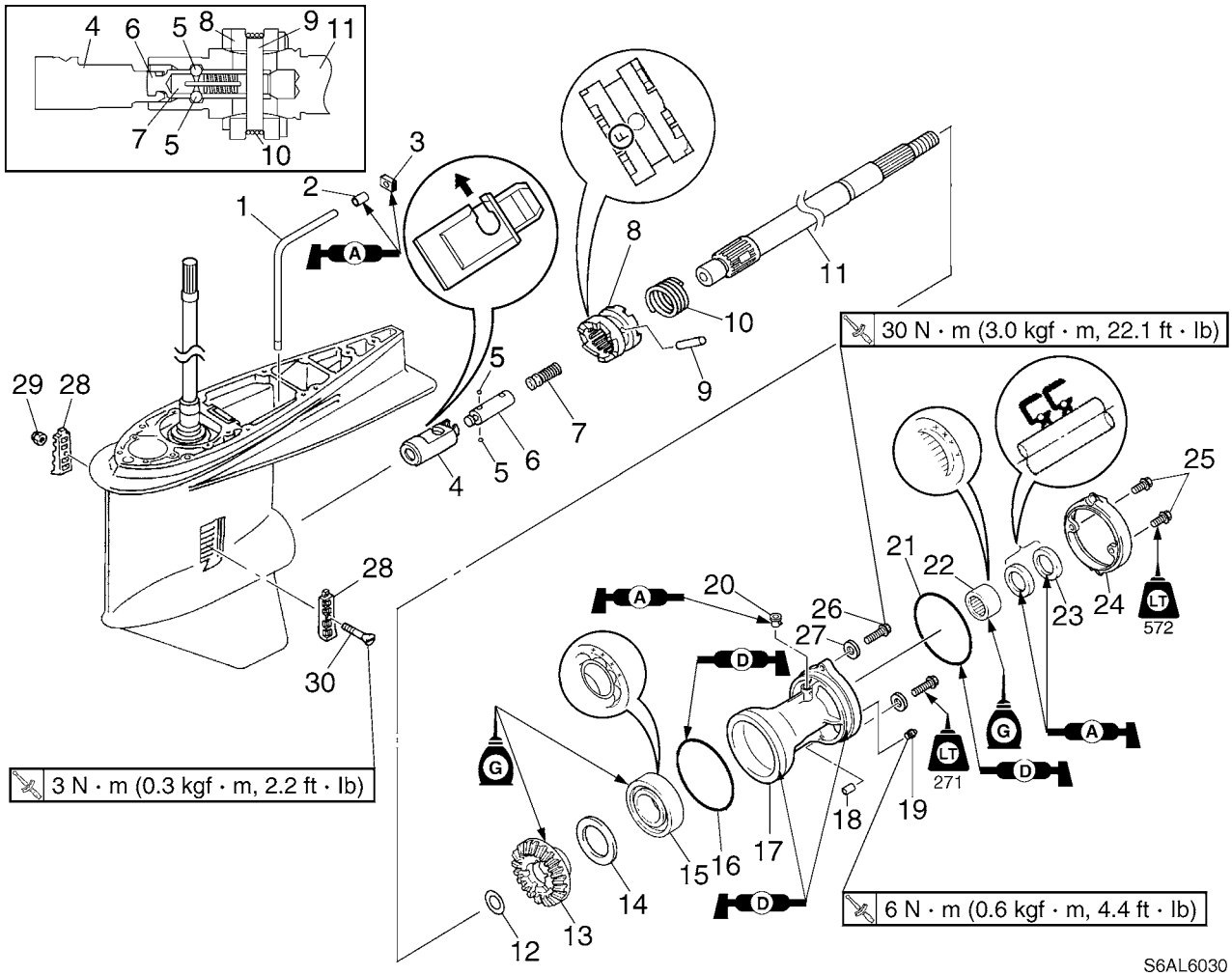
Checking the water pump and shift rod

1. Check the water pump housing. Replace if there is deformation.

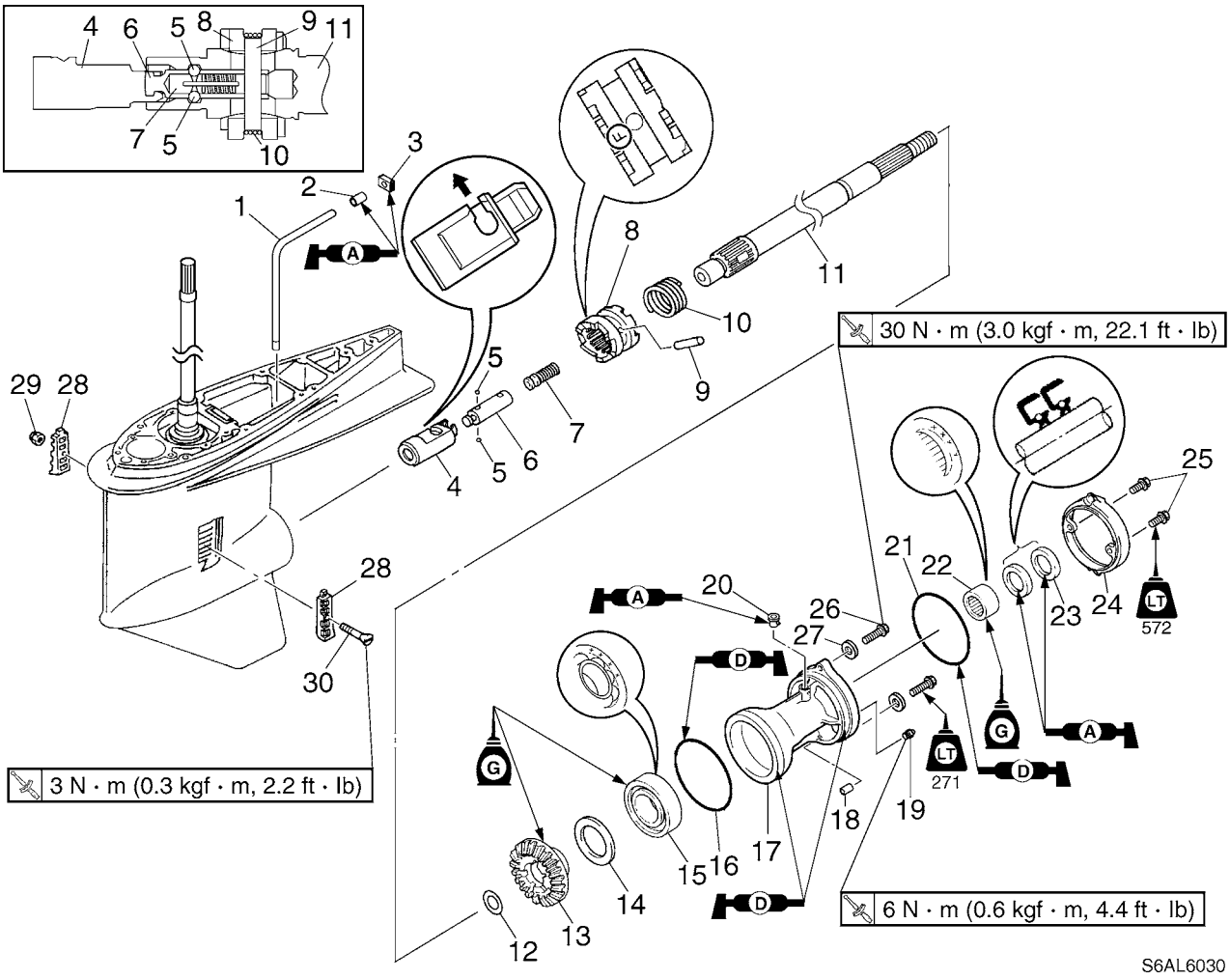
NOTE:
If the engine overheated, the inside of the water pump housing may be deformed, so be sure to remove the insert cartridge when checking the housing.

2. Check the impeller, insert cartridge, and outer plate cartridge. Replace if cracked or worn.
3. Check the water pipe. Replace if corrosion, deformation or cracked.
4. Check the Woodruff key and the groove on the drive shaft. Replace if worn.
5. Check the shift rod. Replace if cracked or worn.

Propeller shaft housing (regular rotation model)



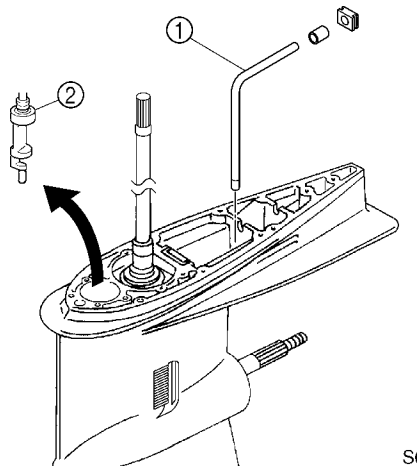
No.	Part name	Q'ty	Remarks
1	Water pipe	1	
2	Rubber seal	1	
3	Rubber seal	1	
4	Shift rod joint	1	
5	Ball	2	
6	Slider	1	
7	Shift plunger	1	
8	Dog clutch	1	
9	Cross pin	1	
10	Spring	1	
11	Propeller shaft	1	
12	Propeller shaft shim	1	
13	Reverse gear	1	
14	Reverse gear shim	—	
15	Ball bearing	1	**Not reusable**
16	O-ring	1	**Not reusable**
17	Propeller shaft housing	1	



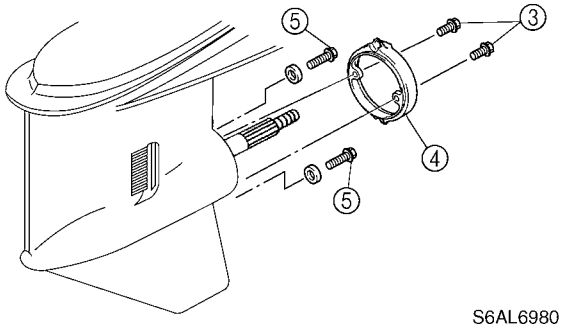
No.	Part name	Q'ty	Remarks
18	Dowel	1	**Not reusable**
19	Grease nipple	1	
20	Rubber seal	1	
21	O-ring	1	**Not reusable**
22	Needle bearing	1	
23	Oil seal	2	**Not reusable**
24	Ring	1	
25	Bolt	2	M8 × 20 mm
26	Bolt	2	M8 × 33 mm
27	Washer	2	
28	Cooling water inlet cover	2	
29	Nut	1	
30	Screw	1	ø5 × 53 mm

Removing the propeller shaft housing assembly

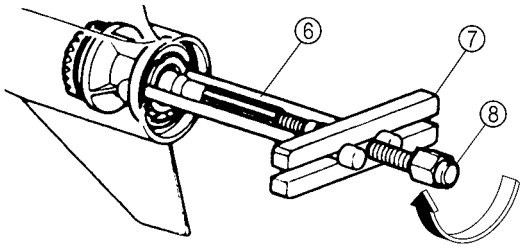
1. Remove the water pipe ① and shift rod ②.



2. Remove the bolts ③, ring ④, and bolts ⑤.



3. Remove the propeller shaft housing, and then remove the propeller shaft.

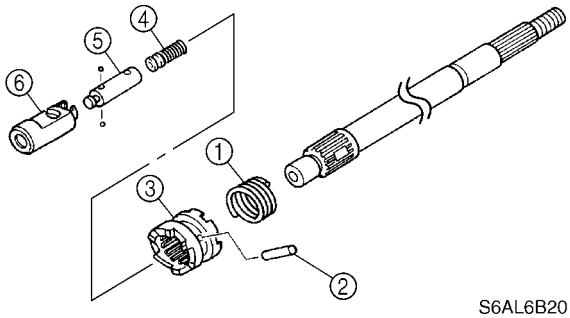


NOTE:
Before removing the propeller shaft from the lower case, remove the shift rod.

Bearing housing puller claw L ⑥: 90890-06502
Stopper guide plate ⑦: 90890-06501
Center bolt ⑧: 90890-06504

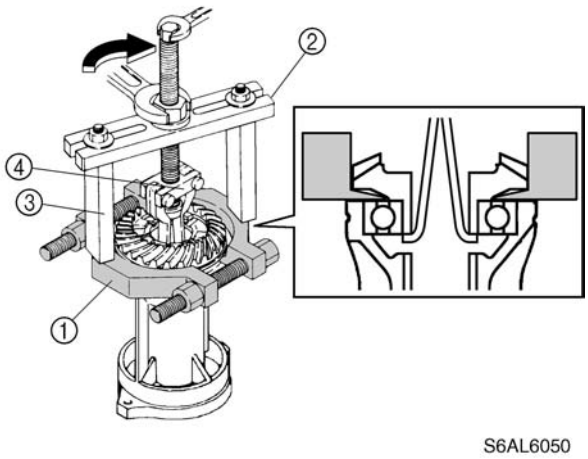
Disassembling the propeller shaft assembly

1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, shift plunger ④, slider ⑤, and shift rod joint ⑥.



Disassembling the propeller shaft housing

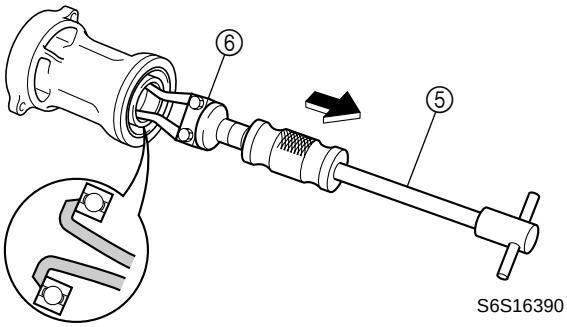
1. Remove the reverse gear and reverse gear shim(s).



Bearing separator ①: 90890-06534
Stopper guide plate ②: 90890-06501
Stopper guide stand ③: 90890-06538
Bearing puller assembly ④: 90890-06535

6

2. Remove the ball bearing.

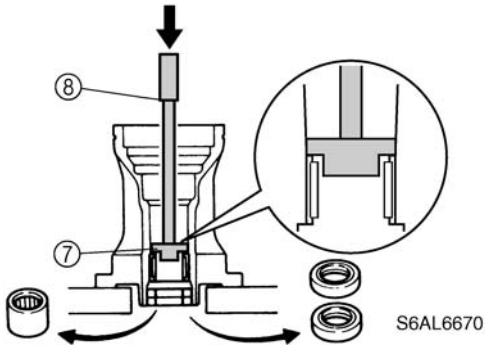


CAUTION:

Do not reuse the bearing, always replace it with a new one.

Slide hammer ⑤: 90890-06531
Bearing outer race puller assembly ⑥:
90890-06523

3. Remove the oil seals and needle bearing.



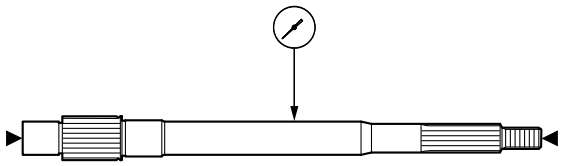
Needle bearing attachment ⑦:
90890-06611
Driver rod L3 ⑧: 90890-06652

Checking the propeller shaft housing

1. Check the water pipe. Replace the water pipe if corrosion, deformation or cracked.
2. Clean the propeller shaft housing, and then check it. Replace the propeller shaft housing if cracked or damaged.
3. Check the teeth and dogs of the reverse gear. Replace reverse gear if cracked or worn.
4. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the propeller shaft

1. Check the propeller shaft. Replace the propeller shaft if bent or worn.
2. Measure the propeller shaft runout. Replace the propeller shaft if above specification.

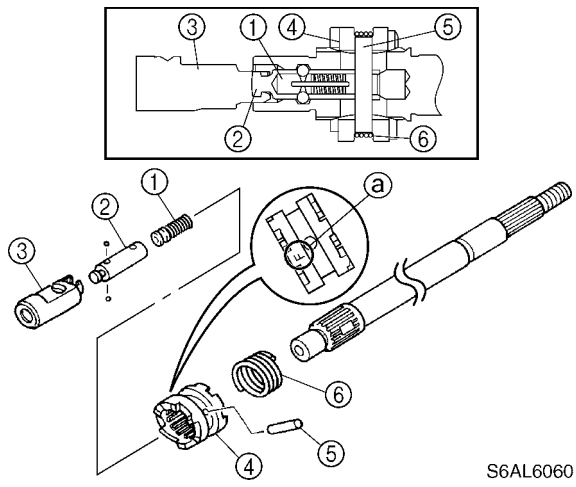


Propeller shaft runout limit:
0.02 mm (0.0008 in)

3. Check the dog clutch, shift rod joint, and slider. Replace the dog clutch, shift rod joint, or slider if cracked or worn.

Assembling the propeller shaft assembly

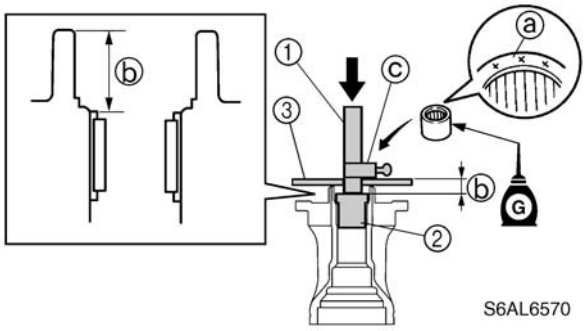
1. Install the shift plunger ①, slider ②, shift rod joint ③, dog clutch ④ and cross pin ⑤, and then install the spring ⑥ as shown.



NOTE:
Install the dog clutch ④ with the "F" mark ⓐ facing toward the shift rod joint ③.

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.

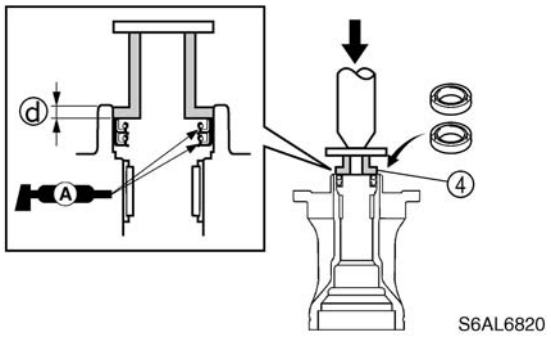


NOTE:
- Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special service tool in a manner that will force the stopper ⓒ out of place.

Driver rod SS ①: 90890-06604
Needle bearing attachment ②: 90890-06610
Bearing depth plate ③: 90890-06603

Depth ⓑ:
25.3 ± 0.25 mm (1.00 ± 0.01 in)

2. Apply grease to new oil seals, and then install them into the propeller shaft housing to the specified depth.

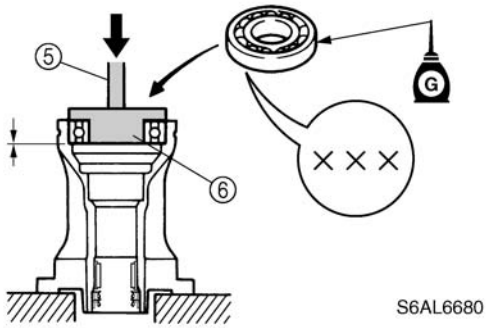


NOTE:
Install an oil seal halfway into the propeller shaft housing, and then install the other oil seal.

Bearing inner race attachment ④:
90890-06640

Depth ⓓ:
5.0 ± 0.25 mm (0.20 ± 0.01 in)

3. Install a new ball bearing into the propeller shaft housing.

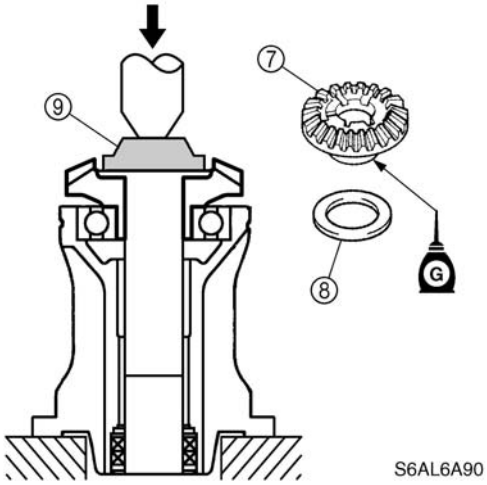


CAUTION:
Do not reuse the bearing, always replace it with a new one.

NOTE:
Install the ball bearing with the manufacture identification mark facing toward the propeller shaft housing (propeller side).

Driver rod LS ⑤: 90890-06606
Ball bearing attachment ⑥:
90890-06656

4. Install the reverse gear ⑦ and original shim(s) ⑧ into the propeller shaft housing using a press.

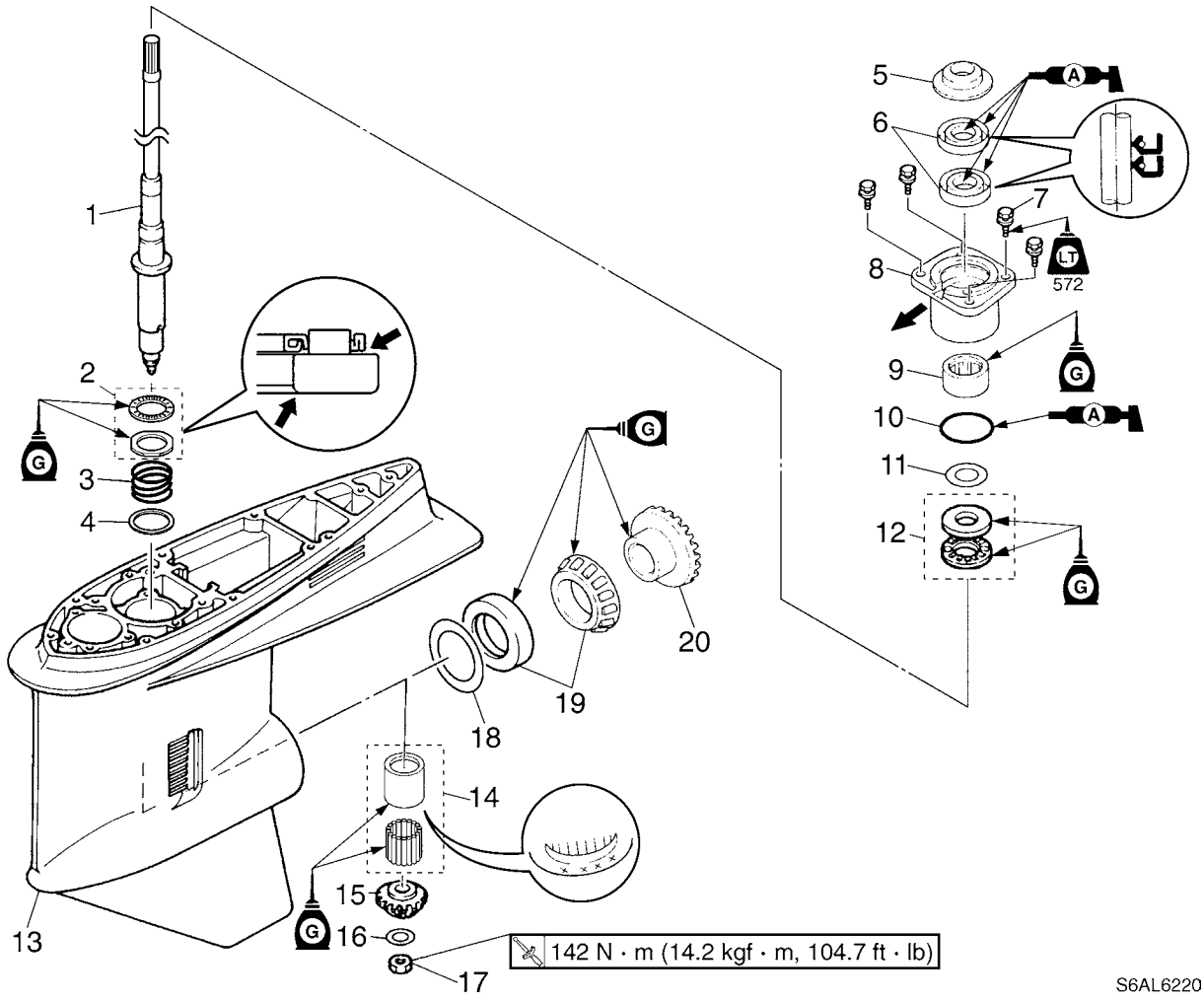


NOTE:

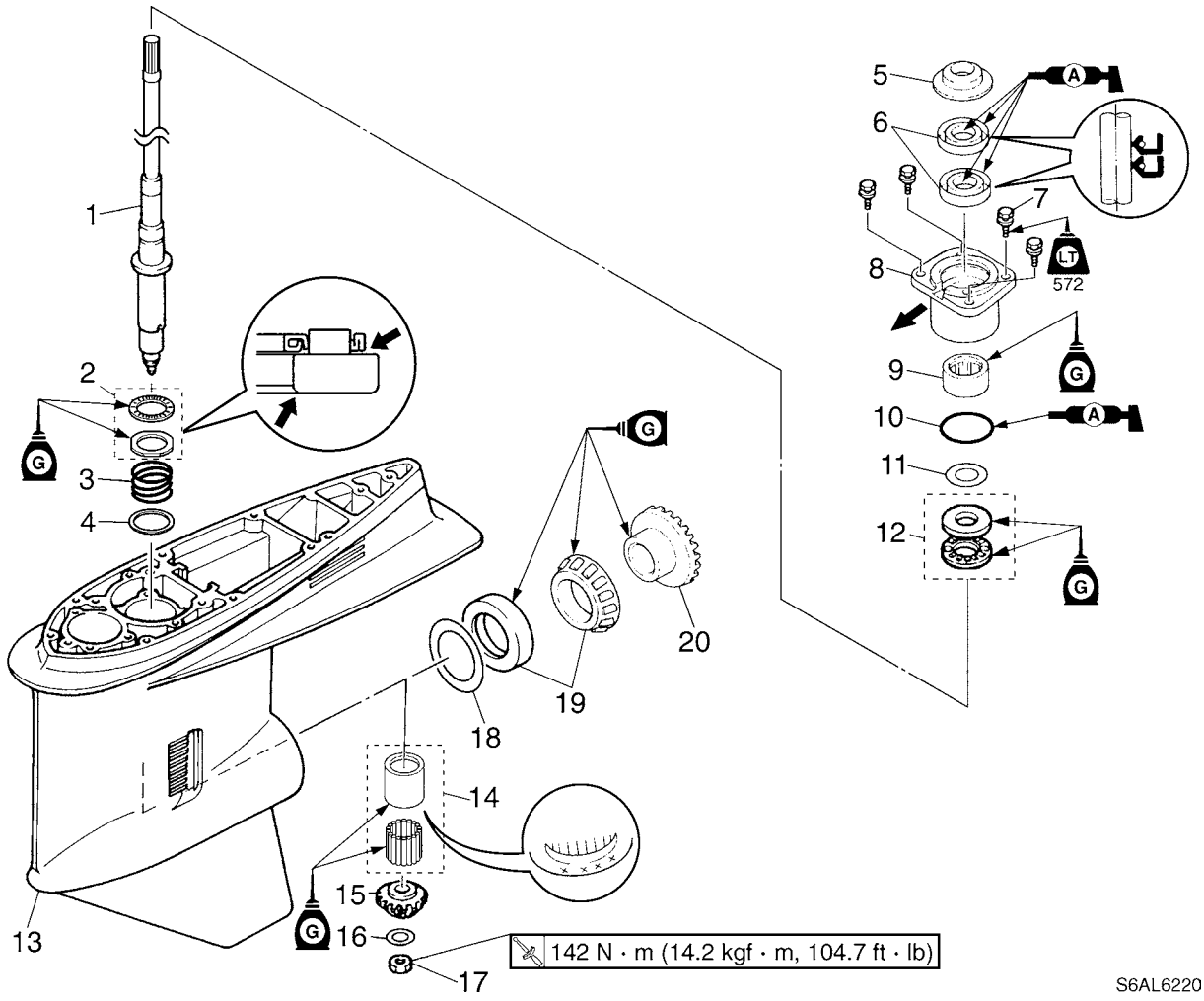
- Be sure to select the reverse gear shim(s) if replacing the propeller shaft housing, ball bearing, or lower case.
- Be sure to select the propeller shaft shim if replacing the reverse gear.
- To select the shims, see Chapter 6, “Shimming (regular rotation model).”
- After installing the reverse gear and shim(s), check that the reverse gear rotates smoothly.

Bearing outer race attachment ⑨:
90890-06622

Drive shaft and lower case (regular rotation model)



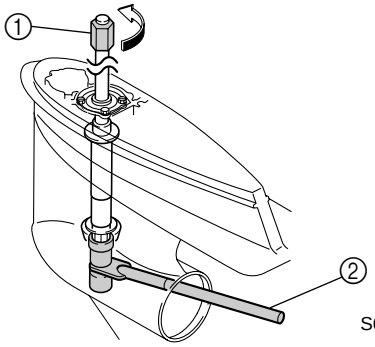
No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Thrust bearing	1	
3	Spring	1	
4	Washer	1	
5	Cover	1	
6	Oil seal	2	**Not reusable**
7	Bolt	4	M8 × 25 mm
8	Drive shaft housing	1	
9	Needle bearing	1	
10	O-ring	1	**Not reusable**
11	Pinion shim	—	
12	Thrust bearing	1	
13	Lower case	1	
14	Needle bearing assembly	1	
15	Pinion	1	
16	Washer	1	
17	Nut	1	



No.	Part name	Q'ty	Remarks
18	Forward gear shim	—	
19	Taper roller bearing assembly	1	**Not reusable**
20	Forward gear	1	

Removing the drive shaft

1. Remove the pinion nut.



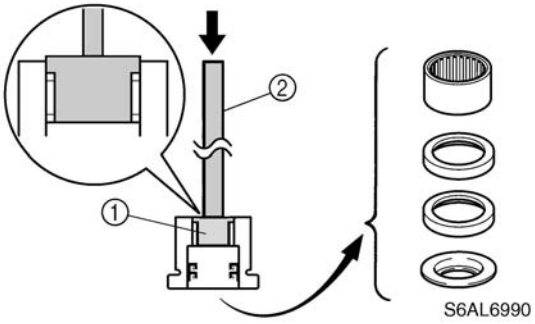
Drive shaft holder 6 ①: 90890-06520
Pinion nut holder ②: 90890-06715

2. Remove the drive shaft, drive shaft housing, pinion, thrust bearing, spring, and washer.

3. Pull out the forward gear.

Disassembling the drive shaft housing

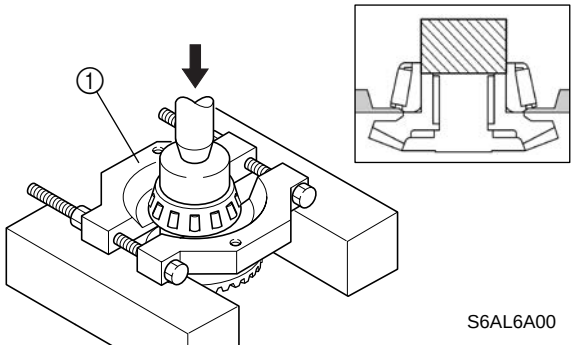
1. Remove the cover, oil seals, and needle bearing.



Needle bearing attachment ①: 90890-06610
Driver rod L3 ②: 90890-06652

Disassembling the forward gear

1. Remove the taper roller bearing from the forward gear using a press.

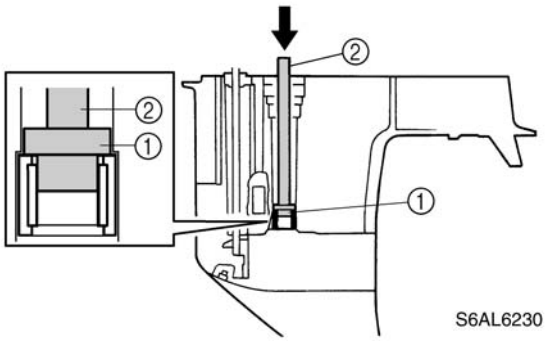


CAUTION:
Do not reuse the bearing, always replace it with a new one.

Bearing separator ①: 90890-06534

Disassembling the lower case

1. Remove the needle bearing from the lower case.

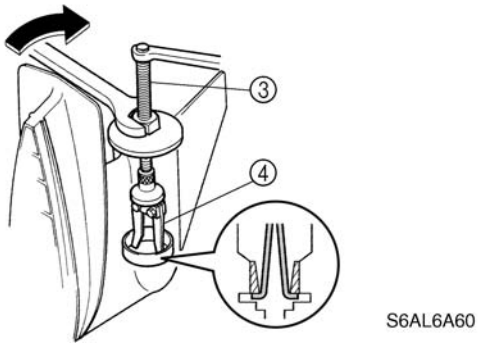


NOTE:
- Since the diameter of the passage in the lower case and the diameter of the special service tool ① are both 40 mm (1.57 in), the special service tool may not fit into the lower case. In that case, use a special service tool with a smaller diameter.
- Be sure to remove the forward gear before removing the needle bearing.

Ball bearing attachment ①: 90890-06655
Driver rod LL ②: 90890-06605

6

2. Remove the taper roller bearing outer race and shim(s).



NOTE:
Install the claws as shown.

Bearing outer race puller assembly ③:
90890-06523
Outer race puller claw A ④:
90890-06532

Checking the pinion and forward gear

1. Check the teeth of the pinion, and the teeth and dogs of the forward gear. Replace the pinion or forward gear if cracked or worn.

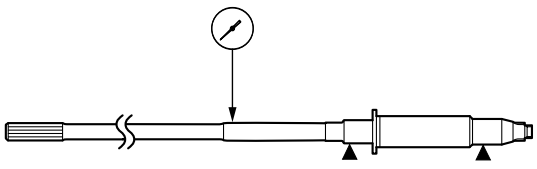
Checking the bearing

1. Check the bearings. Replace the bearing if pitted or if there is rumbling.

Checking the drive shaft

1. Check the drive shaft. Replace the drive shaft if bent or worn.

2. Measure the drive shaft runout. Replace the drive shaft if above specification.



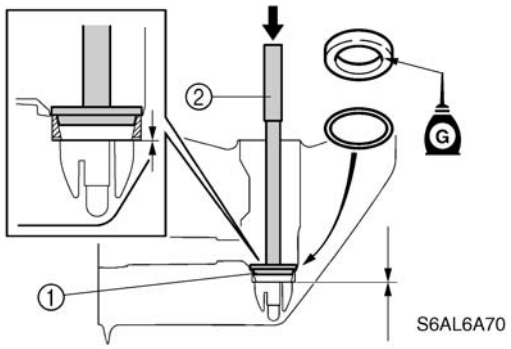
Drive shaft runout limit:
0.2 mm (0.008 in)

Checking the lower case

1. Check the skeg, torpedo, and anti-cavitation plate. Replace the lower case if cracked or damaged.

Assembling the lower case

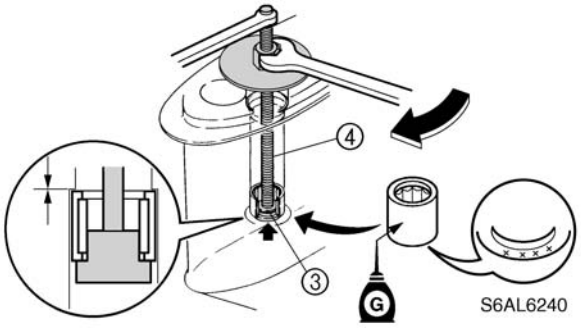
1. Install the original shim(s) and taper roller bearing outer race.



NOTE:
- Be sure to select the forward gear shim(s) if replacing the lower case or taper roller bearing assembly.
- Be sure to select the propeller shaft shim if replacing the forward gear.
- To select the shims, see Chapter 6, “Shimming (regular rotation model).”

Bearing outer race attachment ①:
90890-06658
Driver rod LL ②: 90890-06605

2. Install the needle bearing into the lower case.

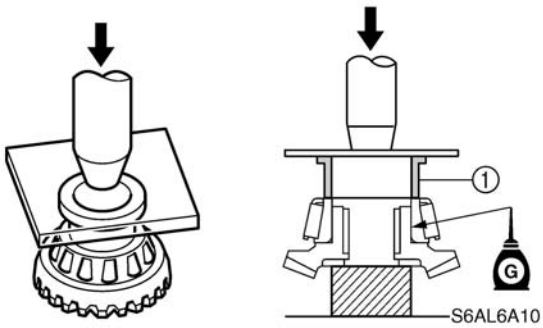


NOTE:
- Apply gear oil to the needle bearing outer case before installation.
- The needle bearing contains 24 rollers.

Ball bearing attachment ③:
90890-06655
Bearing outer race puller assembly ④:
90890-06523

Assembling the forward gear

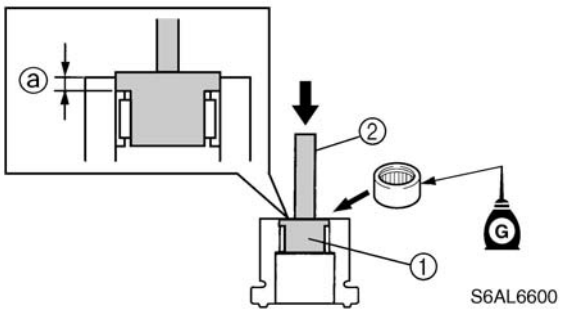
1. Install a new taper roller bearing into the forward gear using a press.



Bearing inner race attachment ①:
90890-06659

Assembling the drive shaft housing

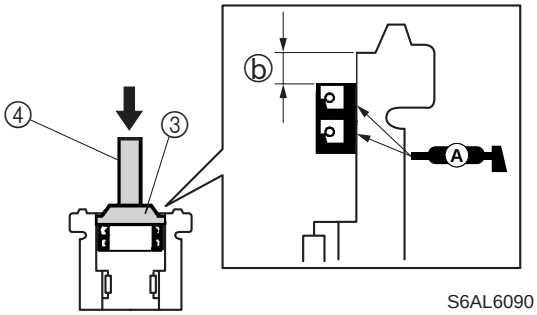
1. Install the needle bearing into the drive shaft housing to the specified depth.



Needle bearing attachment ①:
90890-06610
Driver rod SS ②: 90890-06604

Depth ⓐ:
4.5 ± 0.25 mm (0.18 ± 0.01 in)

2. Apply grease to new oil seals, and then install them into the drive shaft housing to the specified depth.



NOTE:
Install an oil seal halfway into the drive shaft housing, and then install the other oil seal.

Bearing outer race attachment ③:
90890-06628
Driver rod LS ④: 90890-06606

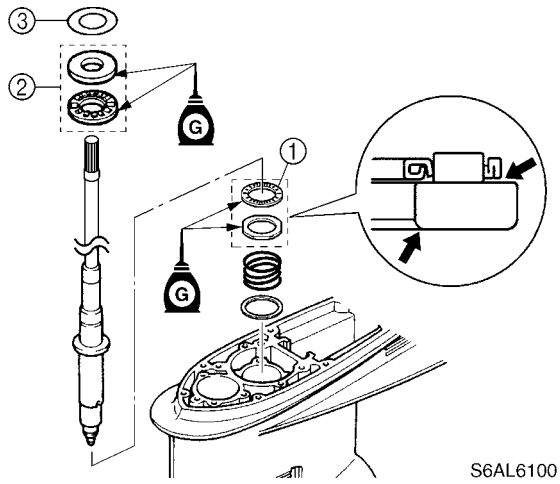
Depth ⓑ:
0.5 ± 0.25 mm (0.02 ± 0.01 in)

Installing the drive shaft

1. Install the forward gear into the lower case.

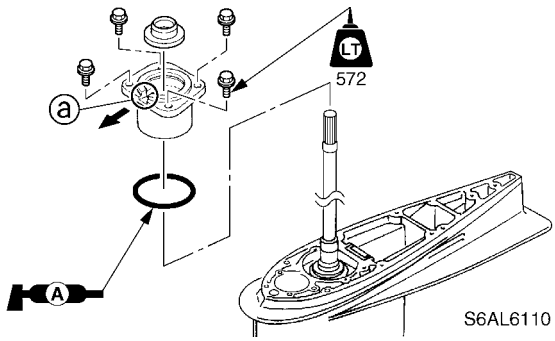
2. Install the washer, spring, thrust bearing ①, drive shaft, thrust bearing ②, and original shim(s) ③ into the lower case.

3. Install the pinion, washer, and pinion nut temporarily.



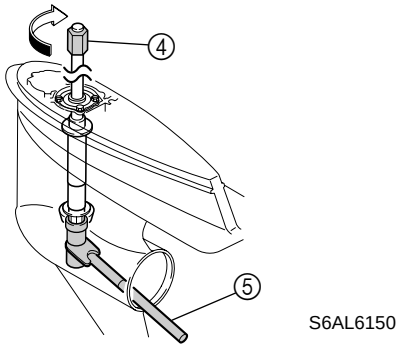
NOTE:
- Be sure to select the pinion shim(s) if replacing the thrust bearing ②, drive shaft housing, drive shaft, or lower case.
- To select the shims, see Chapter 6, "Shimming (regular rotation model)."
- To install the pinion nut, push down on the drive shaft.

4. Install a new O-ring to the drive shaft housing, and then install the drive shaft housing into the lower case.



NOTE:
Install the drive shaft housing with the cutout ⓐ in the housing facing forward as shown.

5. Tighten the pinion nut to the specified torque.



	Drive shaft holder 6 ④: 90890-06520 Pinion nut holder ⑤: 90890-06715

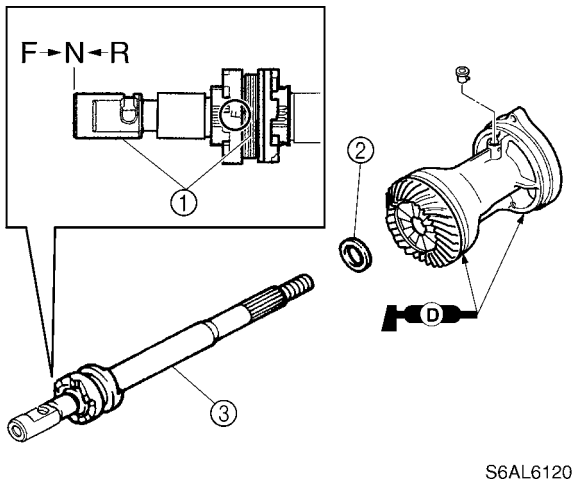
	Pinion nut: 142 N·m (14.2 kgf·m, 104.7 ft·lb)

Installing the propeller shaft housing

1. Set the shift rod joint and dog clutch ① to the neutral position as shown.

2. Install the propeller shaft shim ② and propeller shaft assembly ③ into the propeller shaft housing assembly.

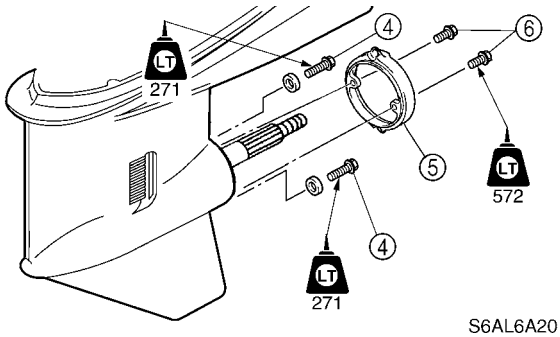
3. Apply grease to new O-rings and propeller shaft housing.



NOTE:
- Be sure to select the propeller shaft shim if replacing the propeller shaft, forward gear, or reverse gear.
- To select the shims, see Chapter 6, “Shimming (regular rotation model).”

4. Install the propeller shaft housing assembly into the lower case, and then tighten the bolts ④ to the specified torque.

5. Install the ring ⑤ and bolts ⑥.



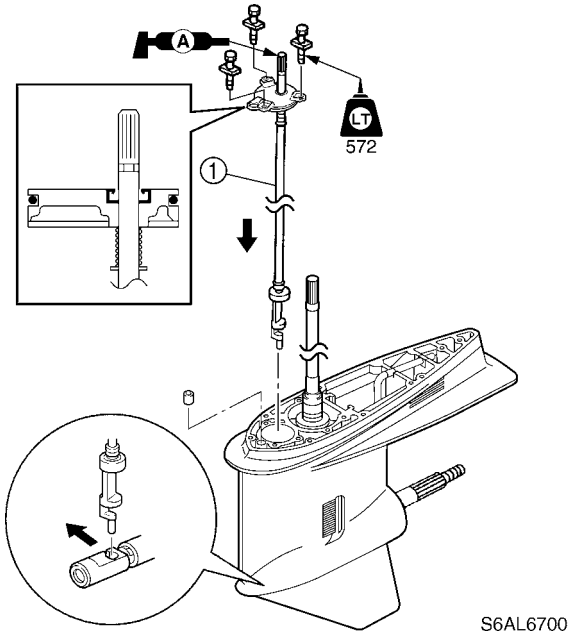
S6AL6A20

	Propeller shaft housing bolt ④: 30 N·m (3.0 kgf·m, 22.1 ft·lb)

6. Install the water pipe and rubber seals.

Installing the water pump and shift rod

1. Install the shift rod assembly ①.

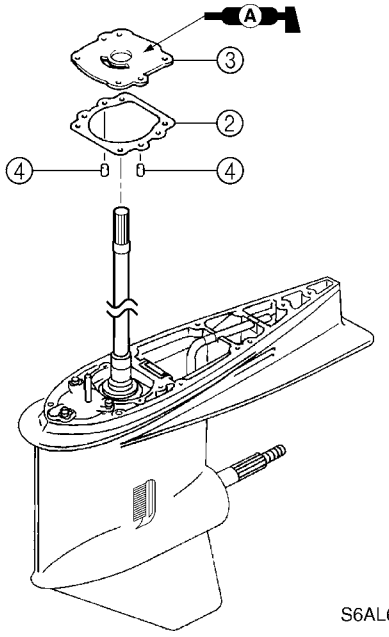


S6AL6700

NOTE:
- Set the gear shift to the neutral position when installing the shift rod.
- After assembling the lower unit, check that the shift rod operates smoothly, and check that the drive shaft and propeller shaft rotate smoothly.
- When measuring the backlash, be sure to measure it before installing the water pump. To measure the backlash, see Chapter 6, “Measuring the forward and reverse gear backlash (regular rotation model).”

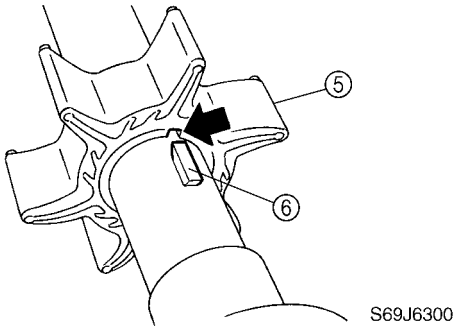
6

2. Install a new gasket ②, the outer plate cartridge ③, and dowels ④.

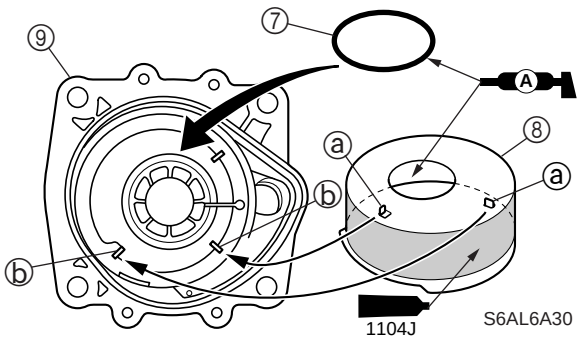


3. Install the Woodruff key ⑥ into the drive shaft.

4. Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.

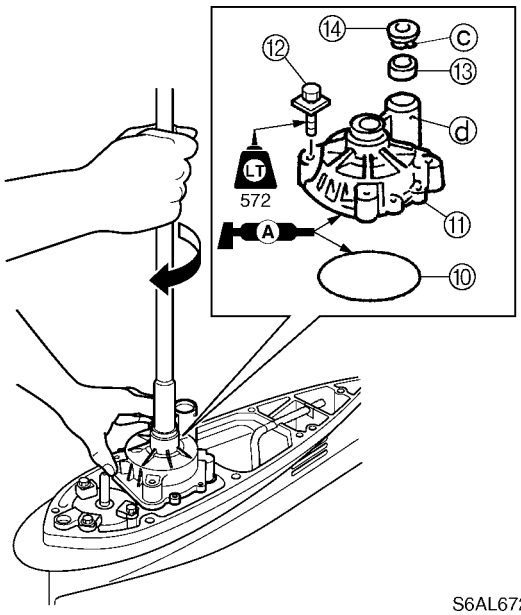


5. Install a new O-ring ⑦ and the insert cartridge ⑧ into the pump housing ⑨.



NOTE:
Align the insert cartridge projections ⓐ with the holes ⓑ in the pump housing.

6. Install a new O-ring ⑩ and the pump housing assembly ⑪ into the lower case, tighten the bolts ⑫, and then install the seal ⑬ and cover ⑭.



CAUTION:
Do not turn the drive shaft counterclockwise, otherwise the water pump impeller may be damaged.

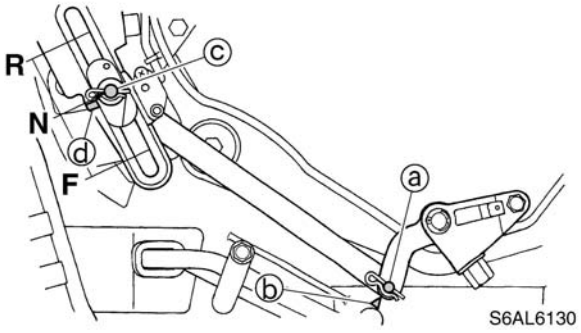
NOTE:
- When installing the pump housing, apply grease to the inside of the insert cartridge, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⓒ with the hole ⓓ in the pump housing.

Installing the lower unit

⚠ WARNING

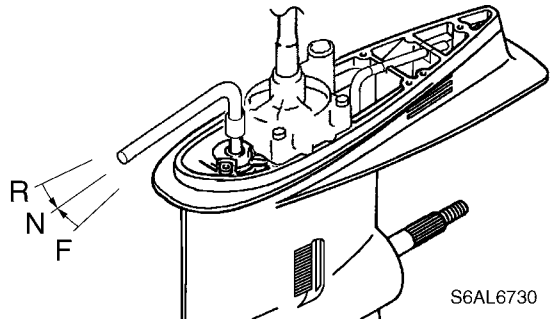
When installing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.

1. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bottom cowling to set the shift lever to the neutral position.



NOTE:
If the power unit is installed, the set pin ⓐ and alignment mark ⓑ cannot be aligned, so align the set pin ⓒ with the alignment mark ⓓ on the shift bracket.

2. Set the gear shift to the neutral position at the lower unit.

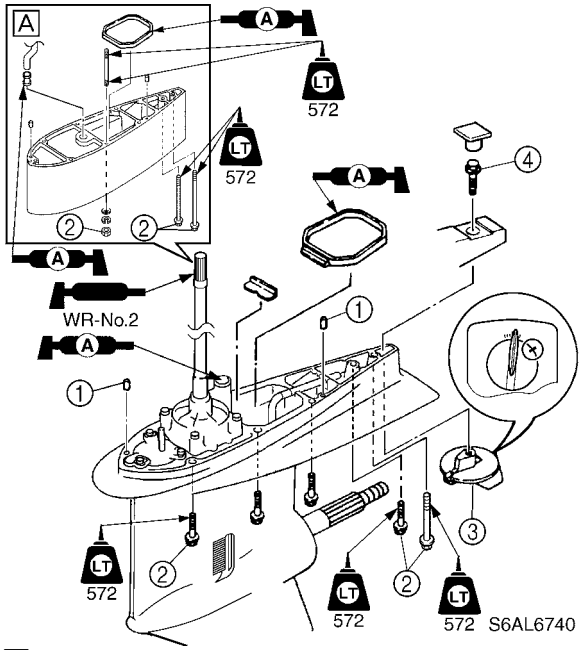


	Shift rod push arm: 90890-06052

3. Install the dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts (nuts) ② to the specified torque.

5. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.

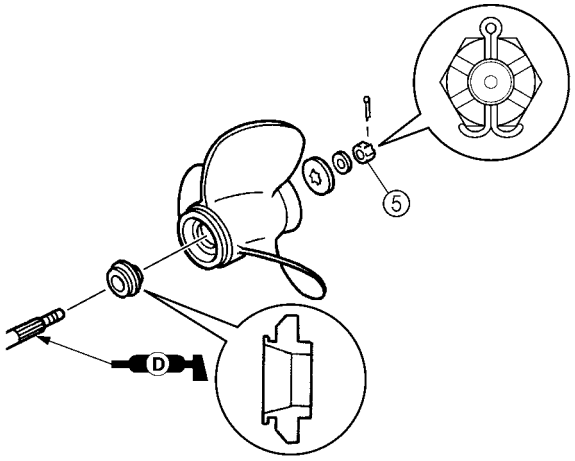


A U-transom model

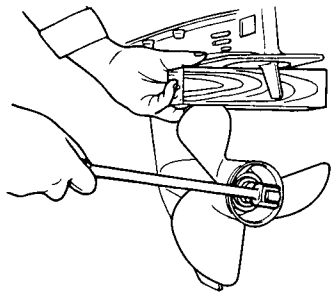
	Lower case mounting bolt (nut) ②: 47 N·m (4.7 kgf·m, 34.7 ft·lb) Trim tab bolt ④: 42 N·m (4.2 kgf·m, 31.0 ft·lb)

6

6. Install the propeller and propeller nut, and then tighten the nut temporarily. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S6AL6A40



S69J6340

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

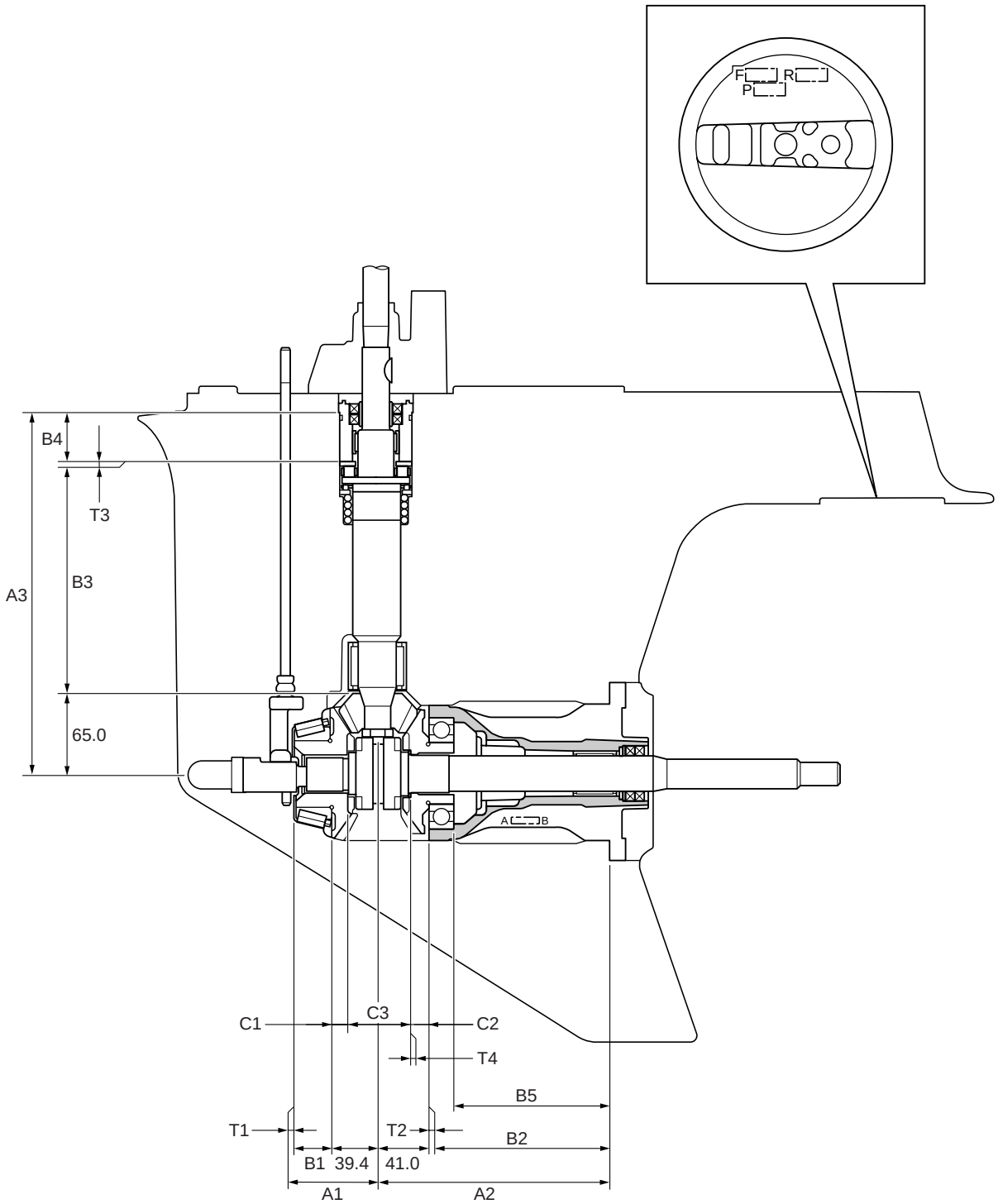
If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.

Propeller nut ⑤:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

7. Fill the gear oil to the correct level.

Recommended gear oil:
Hypoid gear oil
API: GL-4
SAE: 90
Gear oil quantity:
Regular rotation model:
1,150 cm^3
(38.9 US oz, 40.6 Imp oz)

Shimming (regular rotation model)



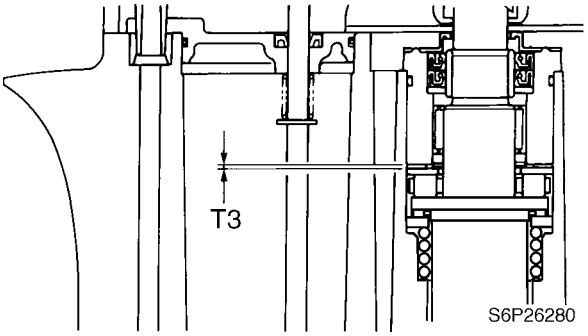
S6P26270

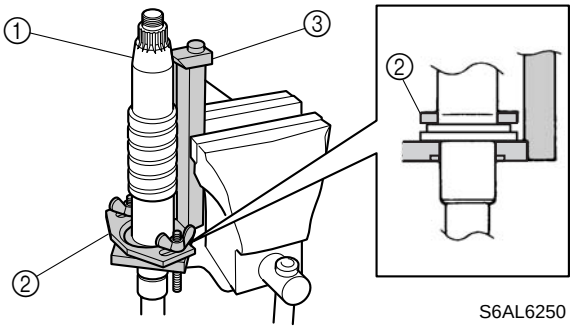
Shimming

NOTE:
- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shim

1. Install the special service tool onto the drive shaft ①.





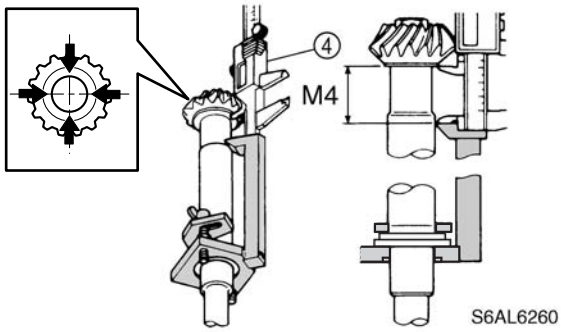
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Hold the special service tool ③ in a vise, and then install the drive shaft ① into the special service tool so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the plate ②.
- Make sure that the special service tool and drive shaft are parallel.

Pinion height gauge ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.

Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

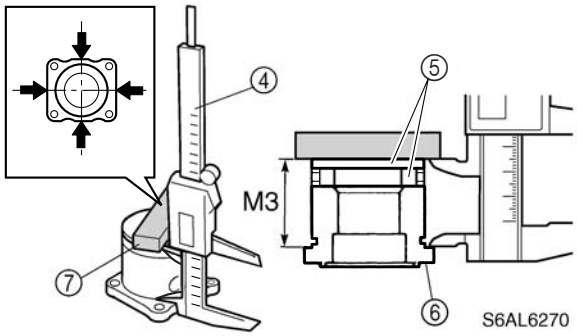
3. Measure the distance (M4) between the special service tool and the pinion as shown.



NOTE:
Measure the pinion at 4 points to find the distance average.

Digital caliper ④: 90890-06704

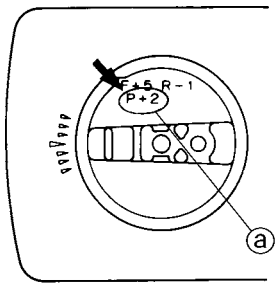
4. Turn the thrust bearing ⑤ 2 or 3 times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.



NOTE:
Measure the thrust bearing at 4 points to find the height average.

Digital caliper ④: 90890-06704
Shimming plate ⑦: 90890-06701

5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "P" mark is unreadable, assume that "P" is zero and measure the backlash when the unit is assembled.

Calculation formula:
Pinion shim thickness (T3) =
82.00 + P/100 – M3 – M4

Example:
If "M3" is 50.75 mm, "M4" is 30.57 mm, and "P" is (+2), then
T3 = 82.00 + (+2)/100 – 50.75 – 30.57 mm
= 82.00 + 0.02 – 50.75 – 30.57 mm
= 0.70 mm
If "M3" is 50.70 mm, "M4" is 30.53 mm, and "P" is (–3), then
T3 = 82.00 + (–3)/100 – 50.70 – 30.53 mm
= 82.00 – 0.03 – 50.70 – 30.53 mm
= 0.74 mm

6. Select the pinion shim(s) (T3) as follows.

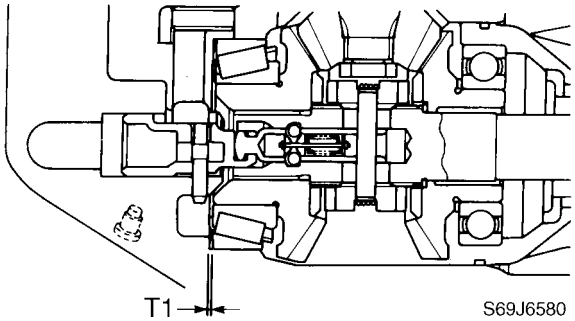
Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

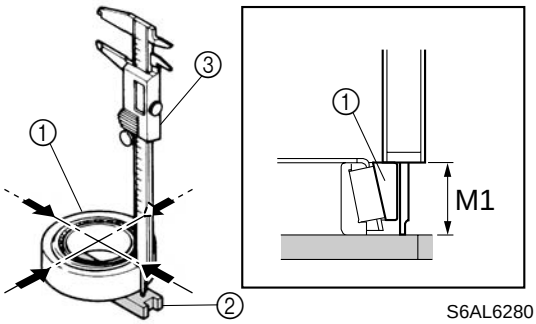
Example:
If "T3" is 0.70 mm, then the pinion shim is 0.68 mm.
If "T3" is 0.74 mm, then the pinion shim is 0.72 mm.

Selecting the forward gear shim

1. Turn the taper roller bearing outer race ① 2 or 3 times to seat the rollers, and then measure the bearing height (M1) as shown.

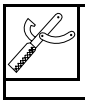


S69J6580



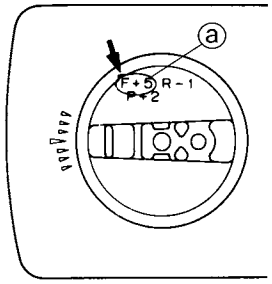
S6AL6280

NOTE:
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at 4 points to find the height average.


Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

6

2. Calculate the forward gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:
"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Calculation formula:
Forward gear shim thickness (T1) =
29.50 + F/100 – M1

Example:
If "M1" is 29.10 mm and "F" is (+5), then
T1 = 29.50 + (+5)/100 – 29.10 mm
= 29.50 + 0.05 – 29.10 mm
= 0.45 mm
If "M1" is 29.10 mm and "F" is (0), then
T1 = 29.50 + (0)/100 – 29.10 mm
= 29.50 + 0 – 29.10 mm
= 0.40 mm

3. Select the forward gear shim(s) (T1) as follows.

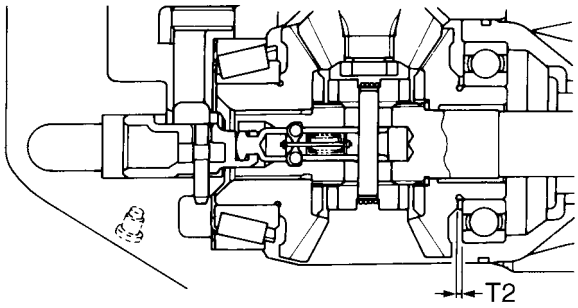
Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

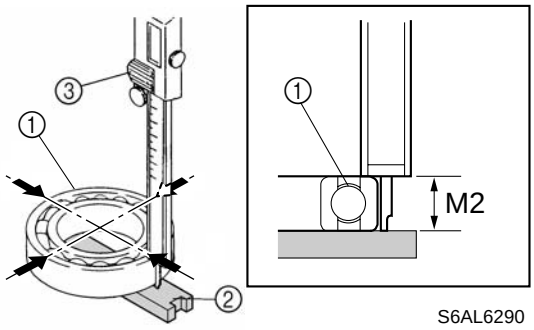
Example:
If "T1" is 0.45 mm, then the forward gear shim is 0.42 mm.
If "T1" is 0.40 mm, then the forward gear shim is 0.38 mm.

Selecting the reverse gear shim

1. Turn the ball bearing ① 2 or 3 times, and then measure the bearing height (M2) as shown.



S69J6595

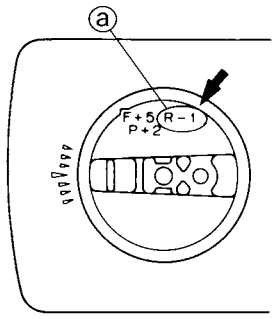


S6AL6290

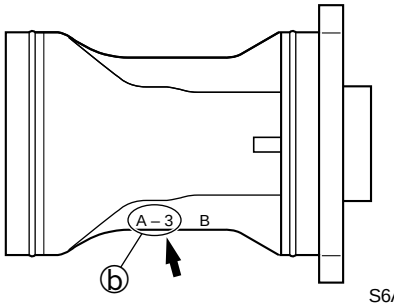
NOTE:
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at 4 points to find the height average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Calculate the reverse gear shim thickness (T2) as shown in the examples below.



S69J6585



S6AL6750

NOTE:

"R" is the deviation of the lower case dimension from standard, and "A" is the deviation of the propeller shaft housing dimension from standard. The "R" mark ⓐ is stamped on the trim tab mounting surface of the lower case, and the "A" mark ⓑ is stamped on the propeller shaft housing in 0.01 mm units. If the "R" mark or "A" mark is unreadable, assume that "R" and "A" are zero and check the backlash when the unit is assembled.

Calculation formula:
Reverse gear shim thickness (T2) =
21.00 + R/100 – A/100 – M2

Example:
If "M2" is 19.92 mm, "R" is (–1), and "A" is (–3), then
T2 = 21.00 + (–1)/100 – (–3)/100 – 19.92 mm
= 21.00 – 0.01 + 0.03 – 19.92 mm
= 1.10 mm
If "M2" is 19.92 mm, "R" is (+3), and "A" is (–5), then
T2 = 21.00 + (+3)/100 – (–5)/100 – 19.92 mm
= 21.00 + 0.03 + 0.05 – 19.92 mm
= 1.16 mm

3. Select the reverse gear shim(s) (T2) as follows.

Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Example:
If "T2" is 1.10 mm, then the reverse gear shim is 1.08 mm.
If "T2" is 1.16 mm, then the reverse gear shim is 1.15 mm.

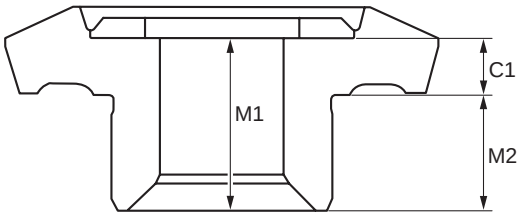
Selecting the propeller shaft shim

NOTE:

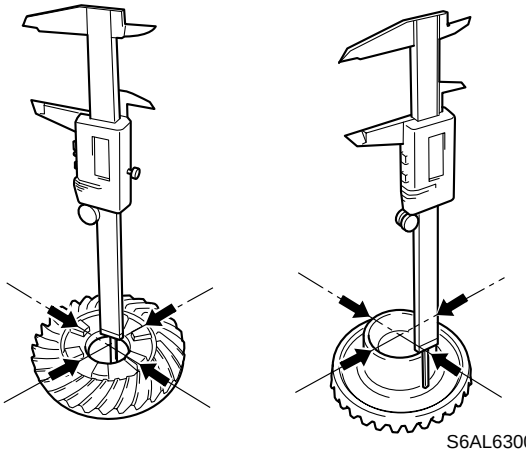
Be sure to make this measurement in metrics.

6

1. Measure the forward gear heights M1 and M2 as shown and then calculate the value C1.



S6P26330



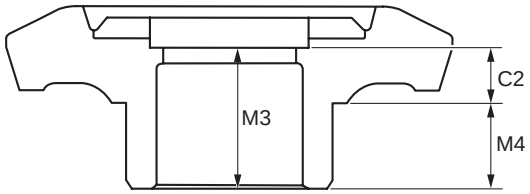
S6AL6300

NOTE:
Measure the gear height at 4 points to find the height average.

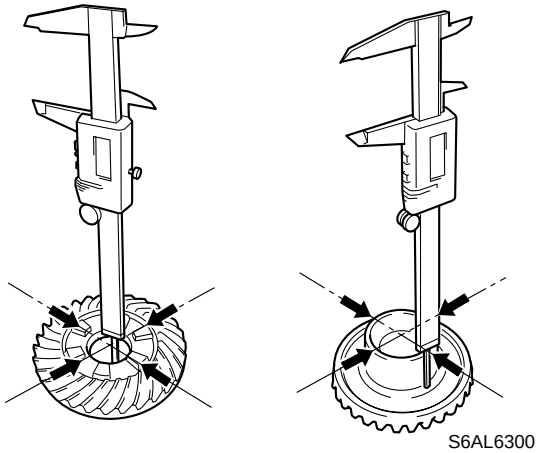
Digital caliper: 90890-06704

Calculation formula:
Forward gear height C1 = M1 – M2

2. Measure the reverse gear heights M3 and M4 as shown, and then calculate the value C2.



S6P26340

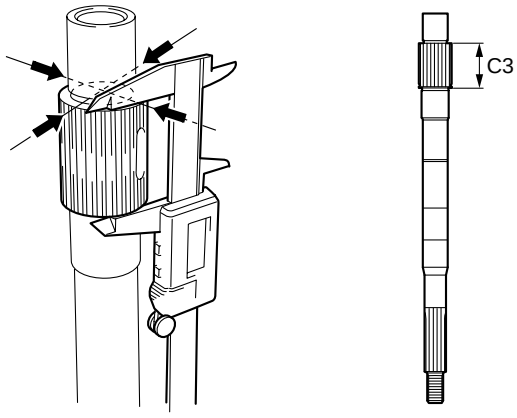


S6AL6300

NOTE:
Measure the gear height at 4 points to find the height average.

Calculation formula:
Reverse gear height C2 = M3 – M4

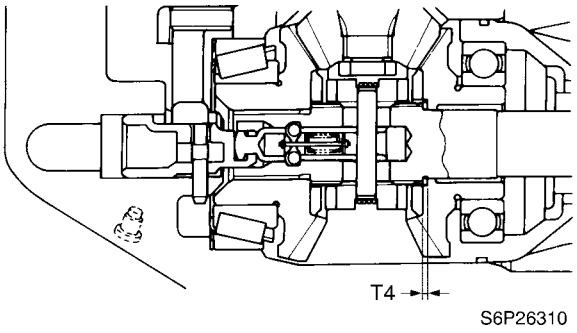
3. Measure the propeller shaft spline width C3.



S6AL6320

NOTE:
Measure the spline width at 4 points to find the width average.

4. Select the propeller shaft shim T4.



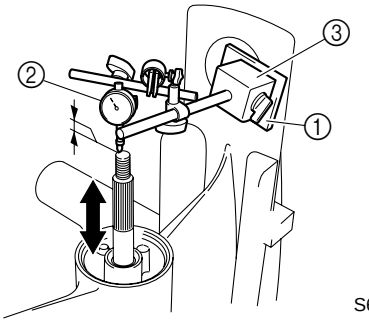
NOTE:
After calculating the shim thickness, select the shim with the closest thickness from the table.

Calculation formula:
Propeller shaft shim thickness T4 =
79.8 – C1 – C2 – C3

Calculated number	Shim thickness (mm)
1.81–1.84	1.80
1.85–1.94	1.90
1.95–2.04	2.00
2.05–2.14	2.10
2.15–2.20	2.20

5. Assemble the lower unit with the selected shim.

6. Measure the propeller shaft axial free play. Reselect the propeller shaft shim if out of specification.



Magnet base plate ①: 90890-07003
Dial gauge set ②: 90890-01252
Magnet base B ③: 90890-06844

Propeller shaft free play:
0.20–0.50 mm (0.0079–0.0197 in)

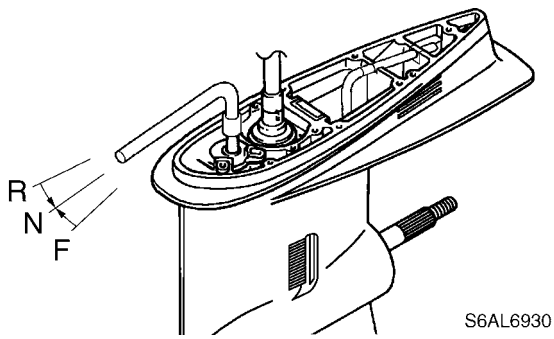
Backlash (regular rotation model)

Measuring the forward and reverse gear backlash

1. Install the lower unit onto a repair stand.

2. Remove the water pump assembly.

3. Set the gear shift to the neutral position at the lower unit.

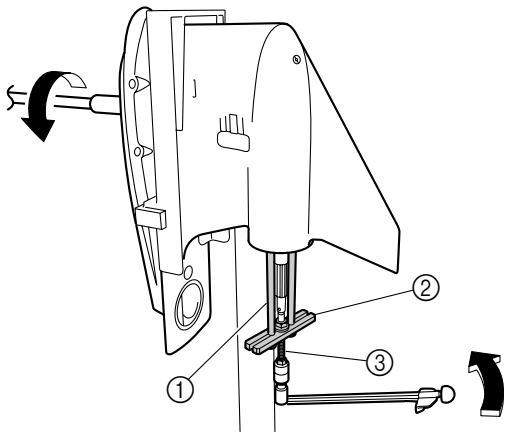


Shift rod push arm: 90890-06052

4. Turn the lower unit so that it is positioned as shown.

5. Install the special service tool.

6. Tighten the center bolt to the specified torque while turning the drive shaft.



S6AL6160

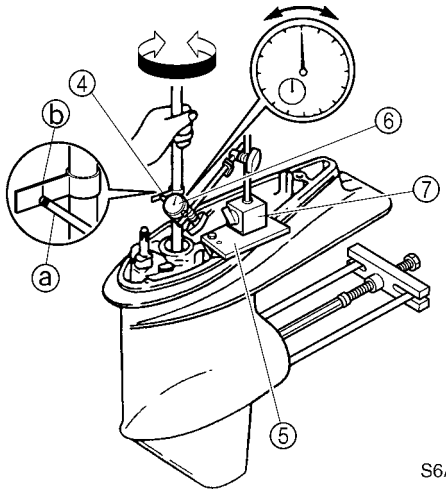
NOTE:
The drive shaft can no longer be turned when the center bolt is tightened to the specified torque.

Bearing housing puller claw L ①: 90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

Center bolt ③:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

7. Turn the lower unit back to its original position.

8. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), and then install the dial gauge.



S6AL6940

NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator rod.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

9. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.

NOTE:
Measure the backlash at 4 points to find the average.

Forward gear backlash:
0.26–0.65 mm (0.0102–0.0256 in)

10. Add or remove shim(s) if out of specification.

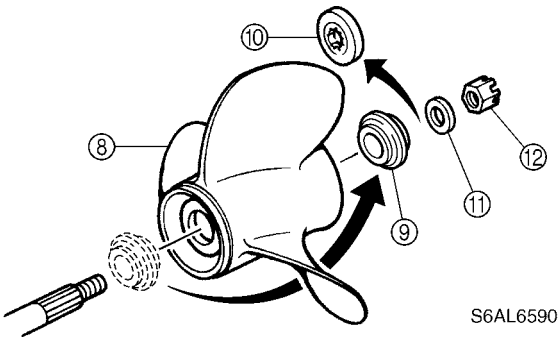
Forward gear backlash	Shim thickness
Less than 0.26 mm (0.0102 in)	To be decreased by (0.46 – M) × 0.71
More than 0.65 mm (0.0256 in)	To be increased by (M – 0.46) × 0.71

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

11. Remove the special service tools from the propeller shaft.

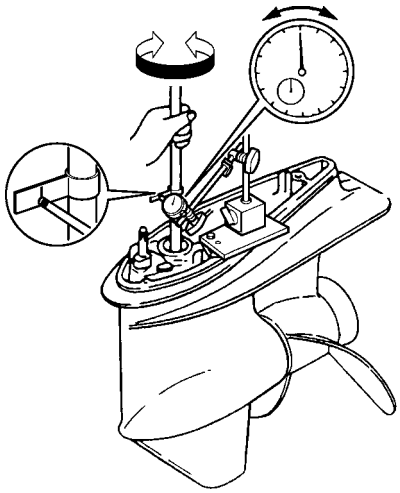
12. Apply a load to the reverse gear by installing the propeller ⑧, spacer ⑨ (without the washer ⑩), and washer ⑪ as shown.



S6AL6590

NOTE:
Tighten the propeller nut ⑫ while turning the drive shaft until the drive shaft can no longer be turned.

13. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.


S6AL6950

NOTE:
Measure the backlash at 4 points to find the average.

Reverse gear backlash:
0.32–0.65 mm (0.0126–0.0256 in)

14. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.32 mm (0.0126 in)	To be decreased by (0.49 – M) × 0.71
More than 0.65 mm (0.0256 in)	To be increased by (M – 0.49) × 0.71

M: Measurement

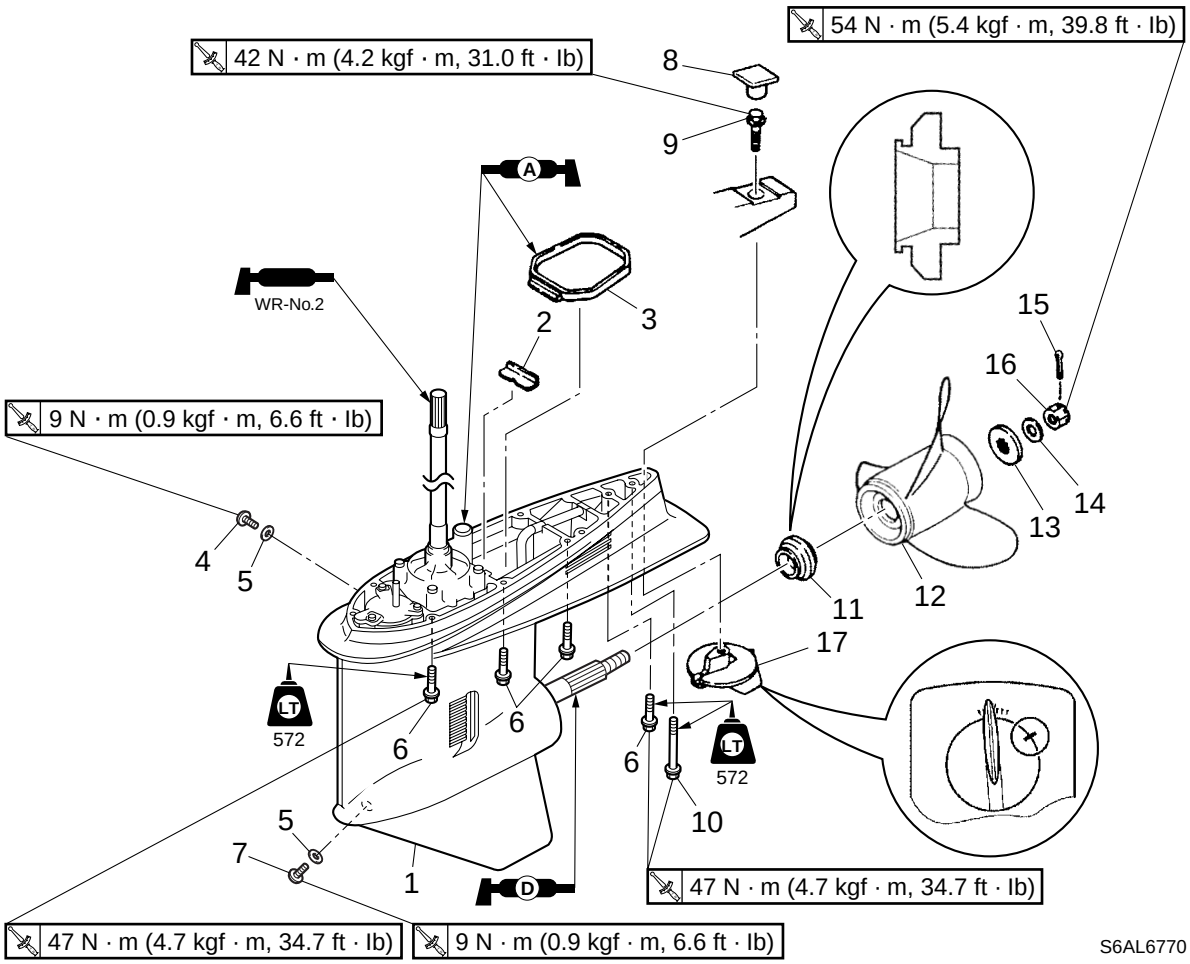
Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

15. Remove the special service tools, and then install the water pump assembly.

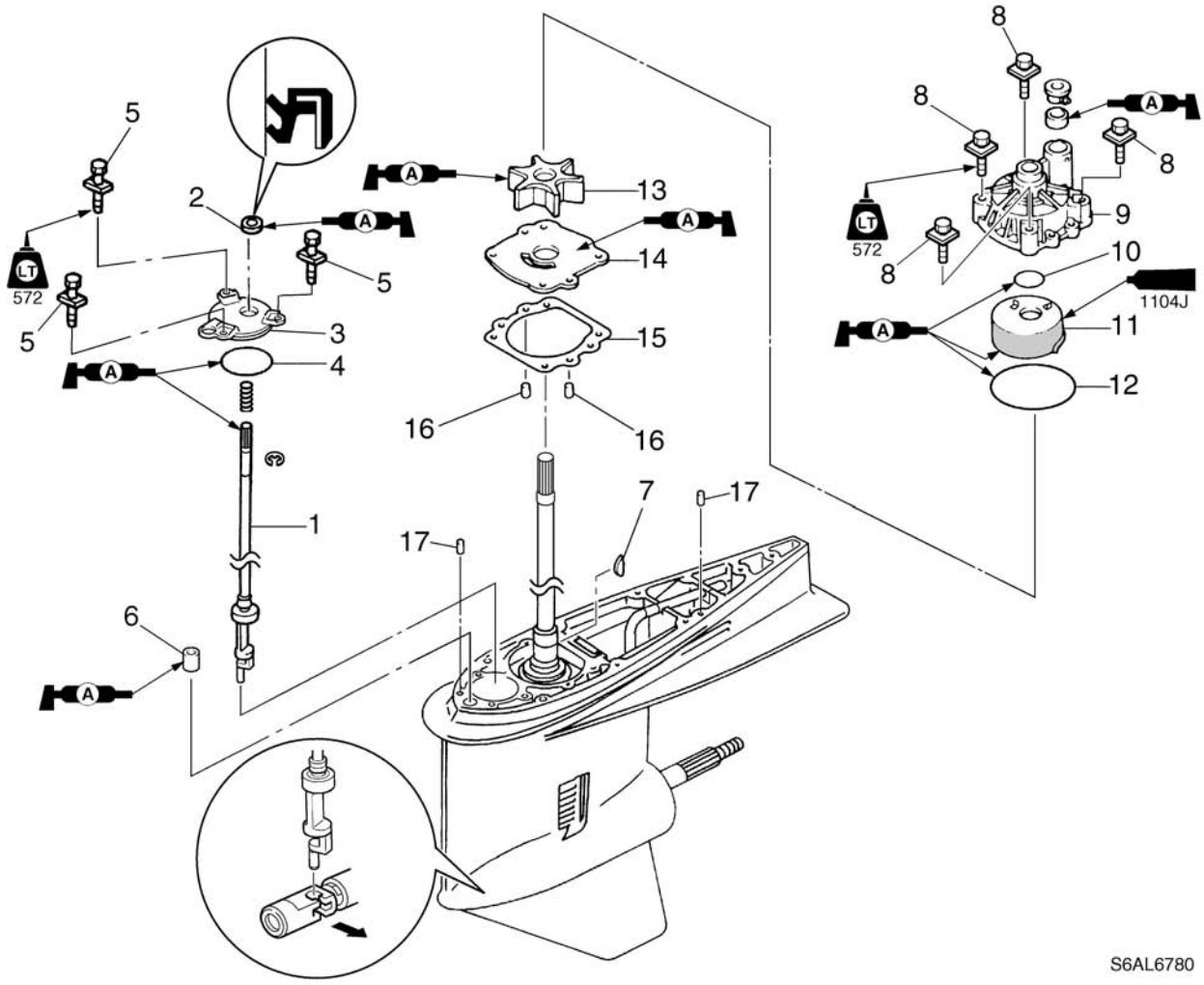
16. Fill the gear oil to the correct level.

6

Lower unit (counter rotation model)



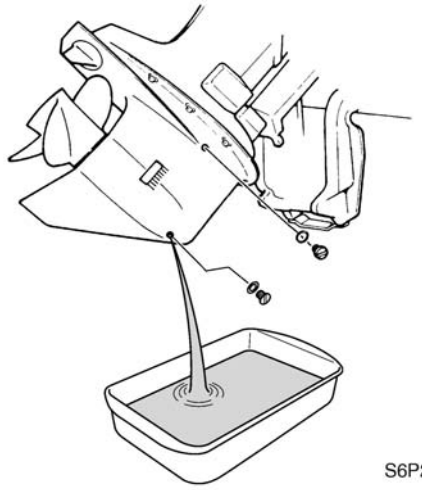
No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	**Not reusable**
6	Bolt	7	M10 × 45 mm
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 45 mm
10	Bolt	1	M10 × 70 mm
11	Spacer	1	
12	Propeller	1	
13	Spacer	1	
14	Washer	1	
15	Cotter pin	1	**Not reusable**
16	Propeller nut	1	
17	Trim tab	1	



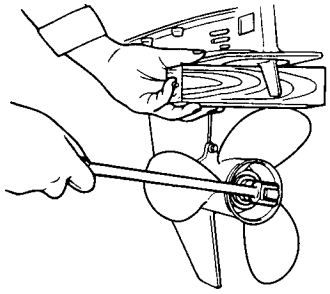
No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	Not reusable
3	Oil seal housing	1	
4	O-ring	1	Not reusable
5	Bolt	3	M6 × 20 mm
6	Seal	1	
7	Woodruff key	1	
8	Bolt	4	M8 × 45 mm
9	Water pump housing	1	
10	O-ring	1	Not reusable
11	Insert cartridge	1	
12	O-ring	1	Not reusable
13	Impeller	1	
14	Outer plate cartridge	1	
15	Gasket	1	Not reusable
16	Dowel	2	
17	Dowel	2	

Removing the lower unit

1. Drain the gear oil.


S6P26400E

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.

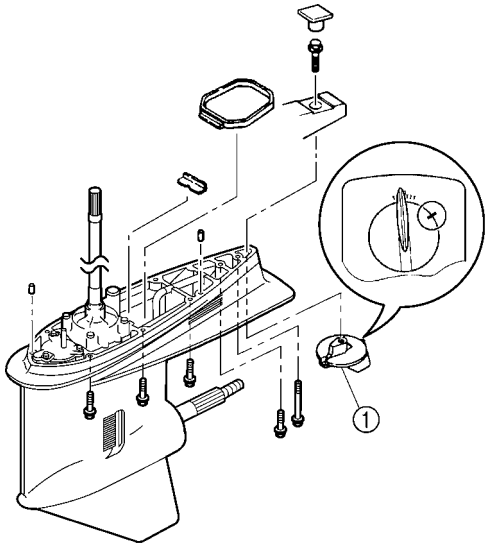

S69J6545

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**
- **When removing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**

3. Mark the trim tab ① at the area shown, and then remove it.

4. Remove the bolts, and then remove the lower unit from the upper case.



S6AL6790

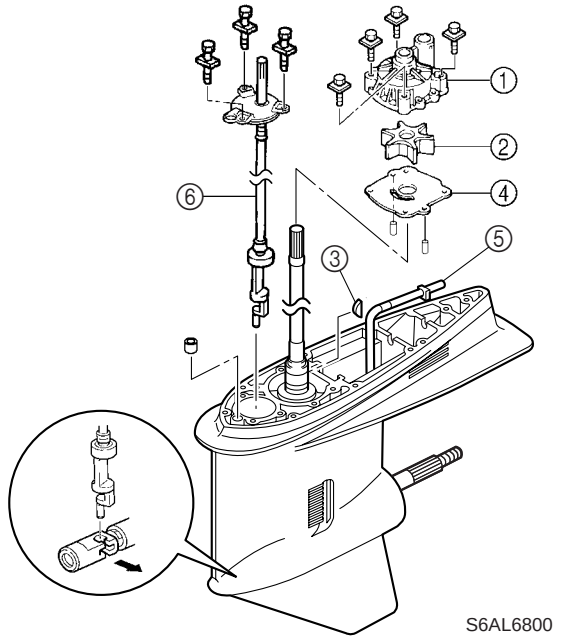
Removing the water pump and shift rod

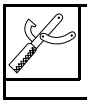
1. Remove the water pump housing ① and impeller ②.

2. Remove the Woodruff key ③.

3. Remove the outer plate cartridge ④ and water pipe ⑤.

4. Set the gear shift to the neutral position, and then remove the shift rod assembly ⑥.




Shift rod push arm: 90890-06052

Checking the water pump and shift rod

1. Check the water pump housing. Replace if there is deformation.

NOTE:
If the engine overheated, the inside of the water pump housing may be deformed, so be sure to remove the insert cartridge when checking the housing.

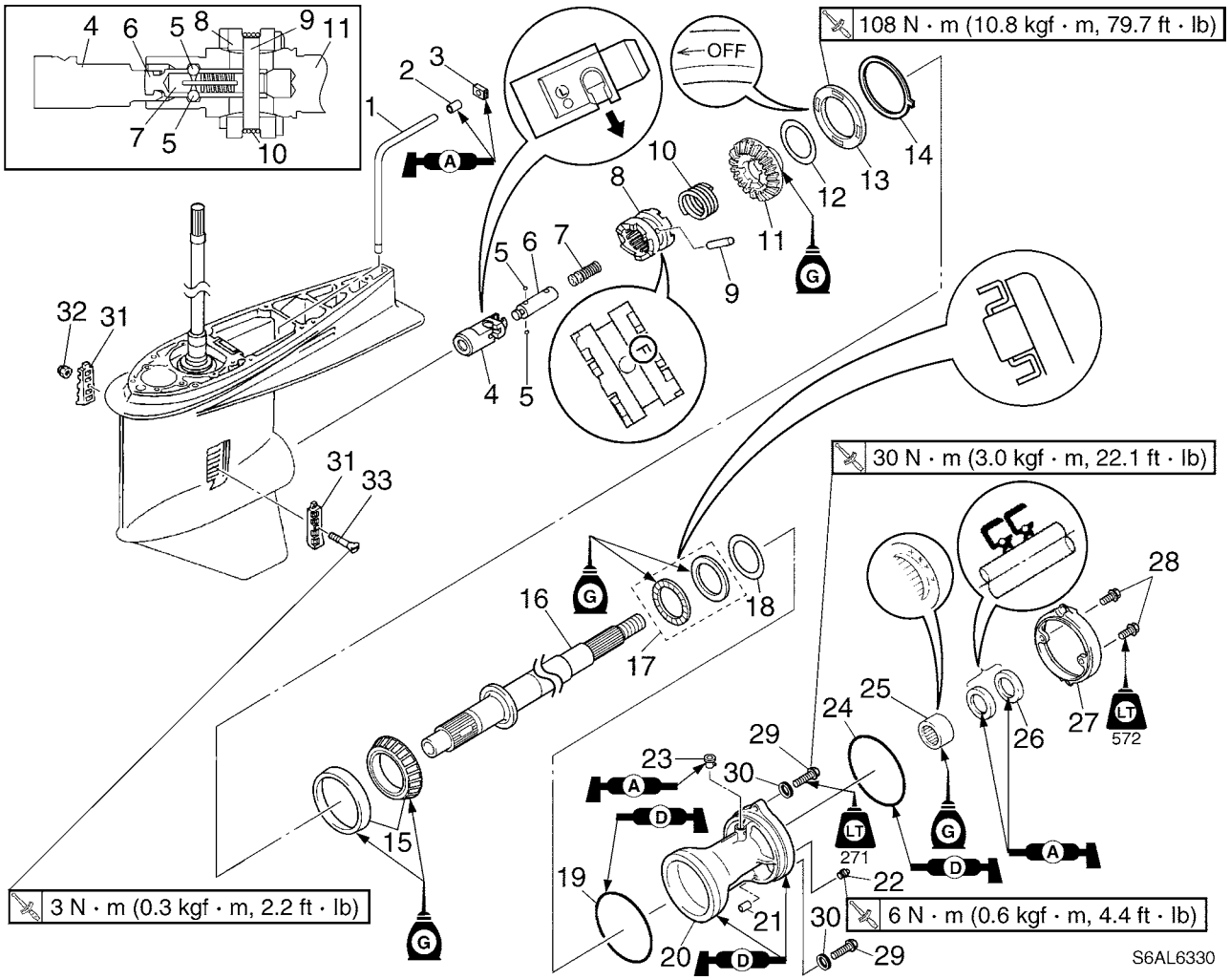
2. Check the impeller, insert cartridge, and outer plate cartridge. Replace if cracked or worn.

3. Check the water pipe. Replace if corrosion, deformation or cracked.

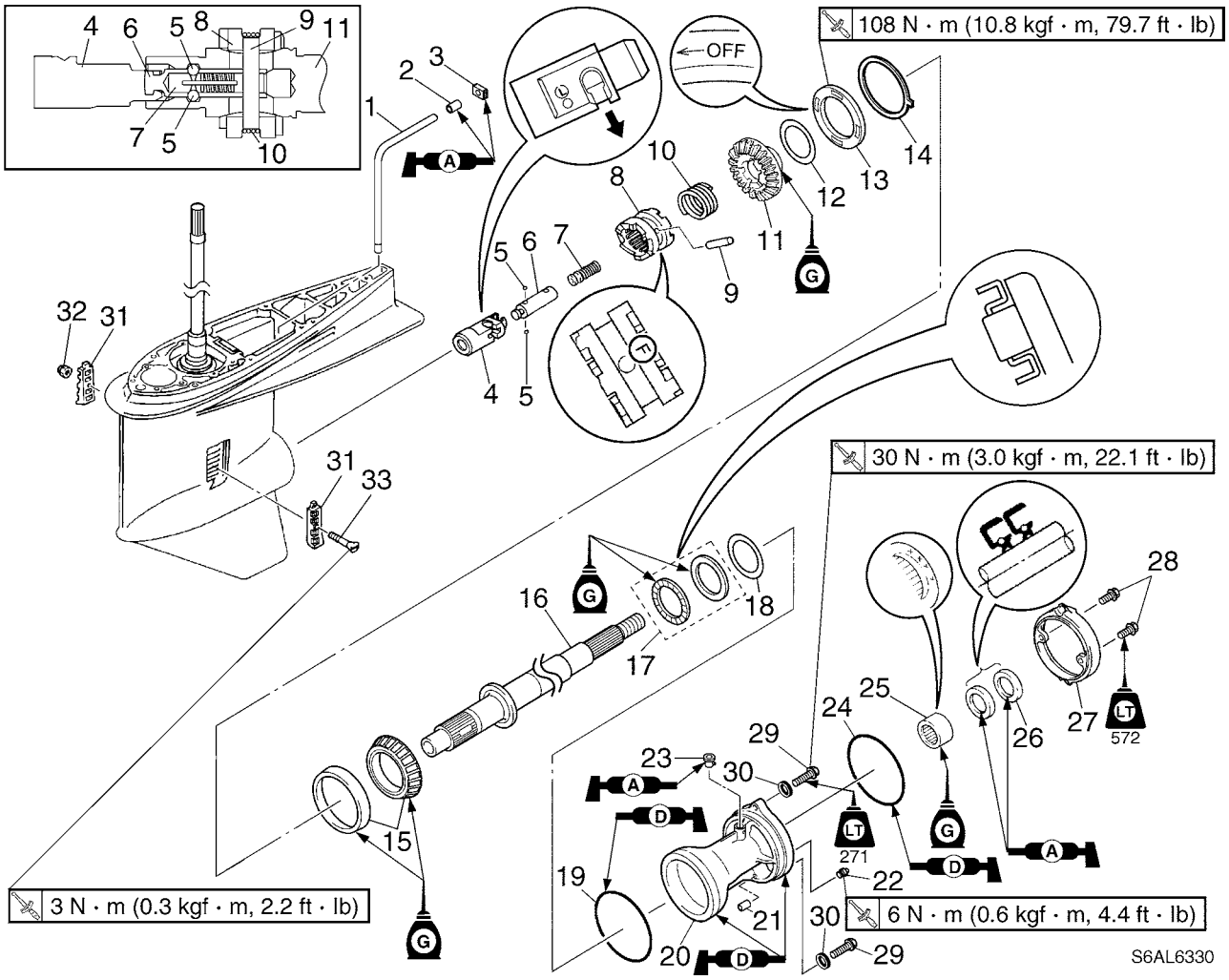
4. Check the Woodruff key and the groove on the drive shaft. Replace if worn.

5. Check the shift rod. Replace if cracked or worn.

Propeller shaft housing (counter rotation model)



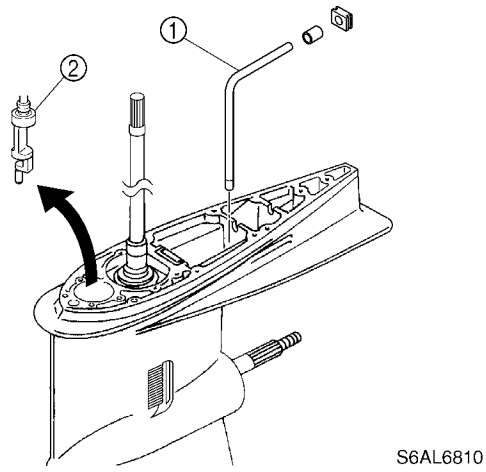
No.	Part name	Q'ty	Remarks
1	Water pipe	1	
2	Rubber seal	1	
3	Rubber seal	1	
4	Shift rod joint	1	
5	Ball	2	
6	Slider	1	
7	Shift plunger	1	
8	Dog clutch	1	
9	Cross pin	1	
10	Spring	1	
11	Forward gear	1	
12	Forward gear shim	—	
13	Ring nut	1	
14	Claw washer	1	
15	Taper roller bearing assembly	1	**Not reusable**
16	Propeller shaft	1	
17	Thrust bearing	1	



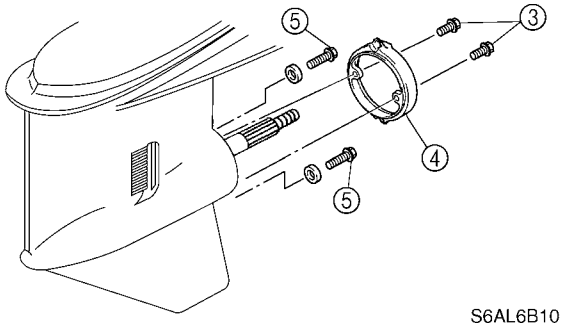
No.	Part name	Q'ty	Remarks
18	Propeller shaft shim	—	
19	O-ring	1	**Not reusable**
20	Propeller shaft housing	1	
21	Dowel	1	**Not reusable**
22	Grease nipple	1	
23	Rubber seal	1	
24	O-ring	1	**Not reusable**
25	Needle bearing	1	
26	Oil seal	2	**Not reusable**
27	Ring	1	
28	Bolt	2	M8 × 20 mm
29	Bolt	2	M8 × 33 mm
30	Washer	2	
31	Cooling water inlet cover	2	
32	Nut	1	
33	Screw	1	ø5 × 53 mm

Removing the propeller shaft housing assembly

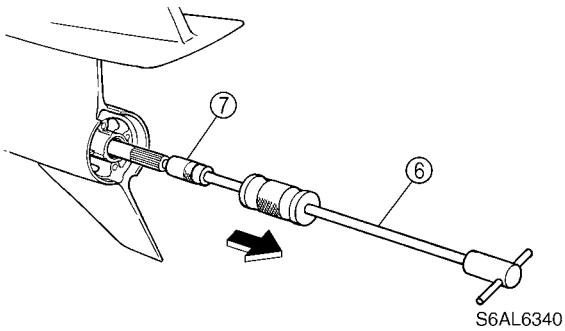
1. Remove the water pipe ① and shift rod ②.



2. Remove the bolts ③, ring ④, and bolts ⑤.



3. Remove the propeller shaft housing with the propeller shaft.

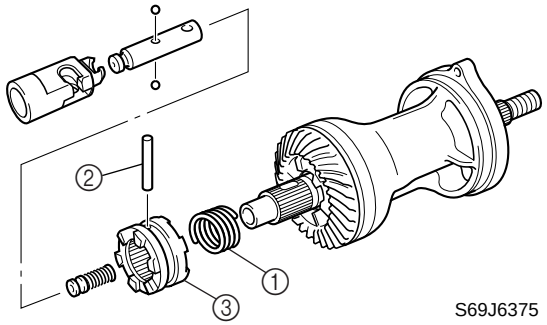


NOTE:
Before removing the propeller shaft from the lower case, remove the shift rod.

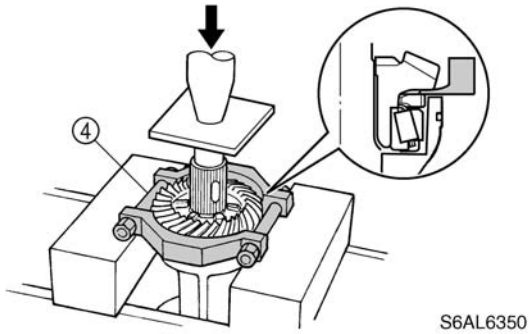
Slide hammer ⑥: 90890-06531
Puller head ⑦: 90890-06514

Disassembling the propeller shaft housing

1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider, shift plunger, and shift rod joint.



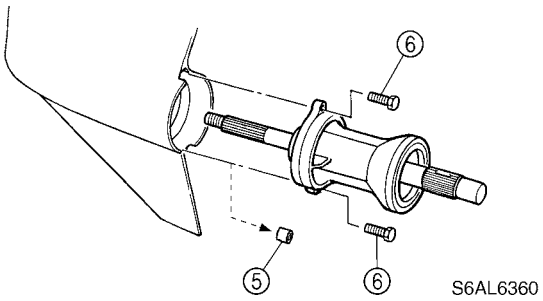
2. Remove the forward gear and forward gear shim(s) from the propeller shaft housing using a press.



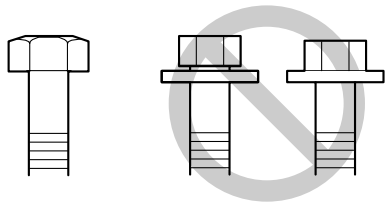
Bearing separator ④: 90890-06534

3. Remove the dowel ⑤ from the lower case.

4. Install the propeller shaft housing assembly in the reverse direction into the lower case.

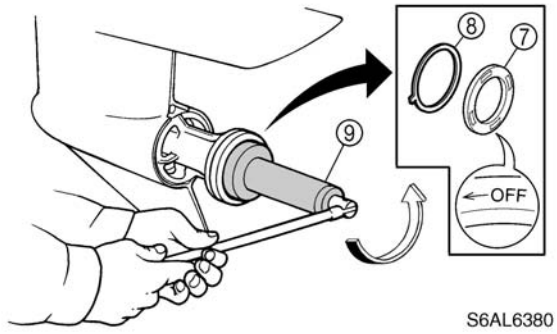


S6AL6360


S6AL6370

NOTE:
To prevent damage to the parts when installing the propeller shaft housing assembly in the reverse direction, use flangeless bolts ⑥ (M8 × 30 mm) without washers.

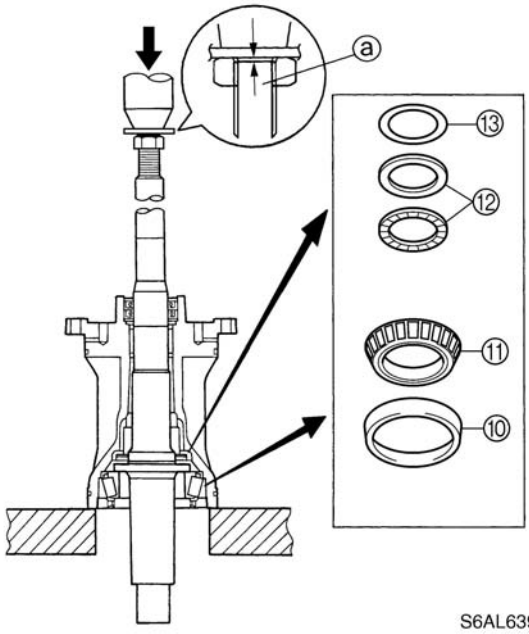
5. Remove the ring nut ⑦ and claw washer ⑧.



S6AL6380

Ring nut wrench ⑨: 90890-06578

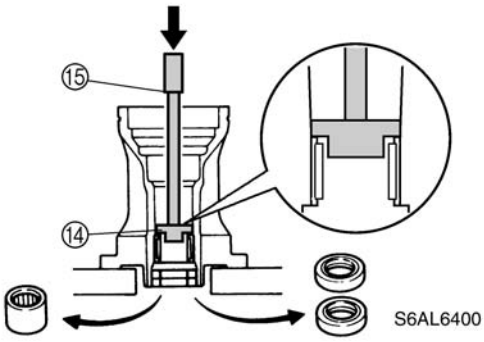
6. Remove the bearing outer race ⑩, taper roller bearing ⑪, thrust bearing ⑫, and propeller shaft shim(s) ⑬ using a press.



S6AL6390

CAUTION:
- **Do not press the propeller shaft threads ⓐ directly.**
- **Do not reuse the taper roller bearing, always replace it with a new one.**

7. Remove the oil seals and needle bearing.



S6AL6400

Needle bearing attachment ⑭: 90890-06611
Driver rod L3 ⑮: 90890-06652

Checking the propeller shaft housing

1. Check the water pipe. Replace the water pipe if corrosion, deformation or cracked.

2. Clean the propeller shaft housing, and then check it. Replace the propeller shaft housing if cracked or damaged.

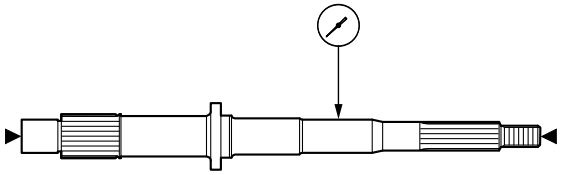
3. Check the teeth and dogs of the forward gear. Replace the forward gear if cracked or worn.

4. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the propeller shaft

1. Check the propeller shaft. Replace the propeller shaft if bent or worn.

2. Measure the propeller shaft runout. Replace the propeller shaft if above specification.



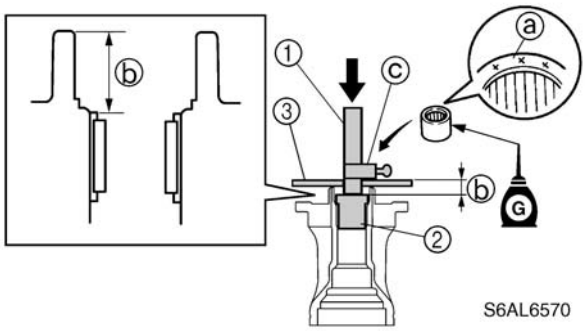
S6P26220C

Propeller shaft runout limit:
0.02 mm (0.0008 in)

3. Check the dog clutch, shift rod joint, and slider. Replace the dog clutch, shift rod joint, or slider if cracked or worn.

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



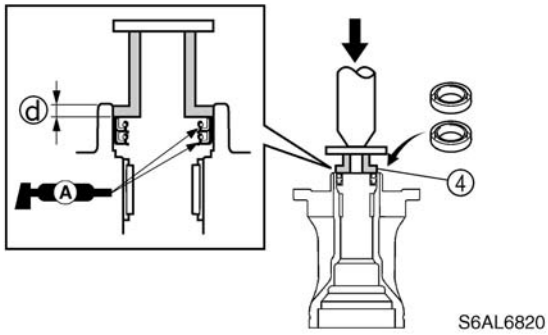
S6AL6570

NOTE:
- Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special service tool in a manner that will force the stopper ⓒ out of place.

Driver rod SS ①: 90890-06604
Needle bearing attachment ②: 90890-06610
Bearing depth plate ③: 90890-06603

Depth ⓑ:
25.3 ± 0.25 mm (1.00 ± 0.01 in)

2. Apply grease to new oil seals, and then install them into the propeller shaft housing to the specified depth.



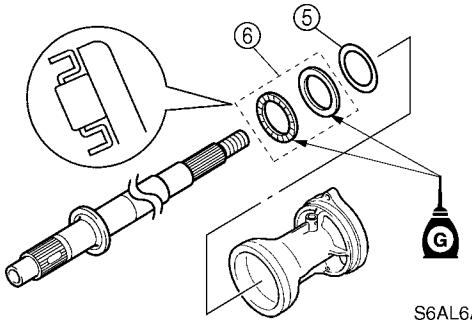
S6AL6820

NOTE:
Install an oil seal halfway into the propeller shaft housing, and then install the other oil seal.

Bearing inner race attachment ④:
90890-06640

Depth ⓓ:
5.0 ± 0.25 mm (0.20 ± 0.01 in)

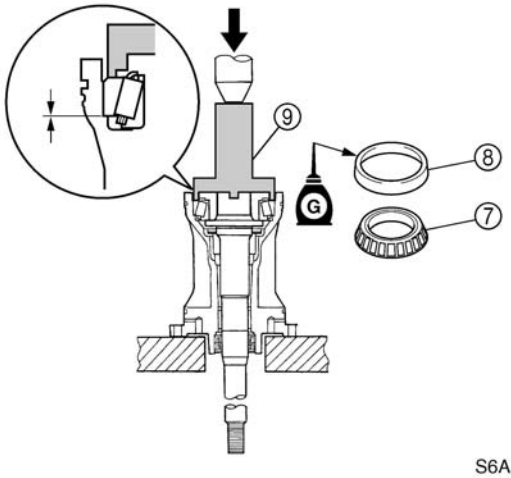
3. Install the original shim(s) ⑤ and thrust bearing ⑥ with the propeller shaft into the propeller shaft housing.



S6AL6A80

NOTE:
- Be sure to select the propeller shaft shim(s) if replacing the propeller shaft, propeller shaft housing, thrust bearing or taper roller bearing.
- To select the shims, see Chapter 6, "Shimming (counter rotation model)."

4. Install a new taper roller bearing ⑦ and the bearing outer race ⑧ into the propeller shaft housing using a press.

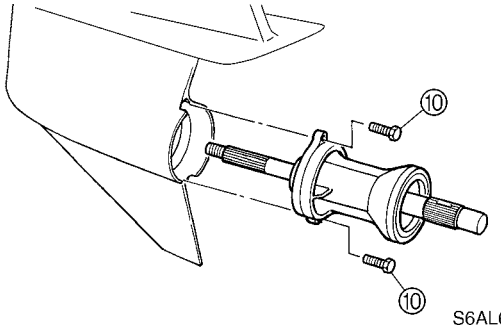


S6AL6830

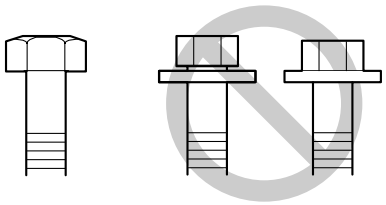
NOTE:
After installing the taper roller bearing and bearing outer race, check that the propeller shaft rotates smoothly.

Ring nut wrench ⑨: 90890-06578

5. Install the propeller shaft housing assembly in the reverse direction into the lower case.

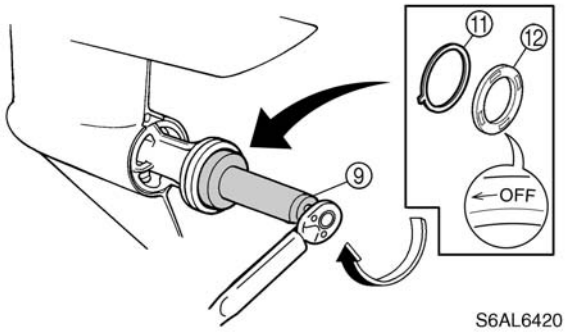


S6AL6410


S6AL6370

NOTE:
To prevent damage to the parts when installing the propeller shaft housing assembly in the reverse direction, use flangeless bolts ⑩ (M8 × 30 mm) without washers.

6. Install the claw washer ⑪ and ring nut ⑫, and then tighten the ring nut to the specified torque.



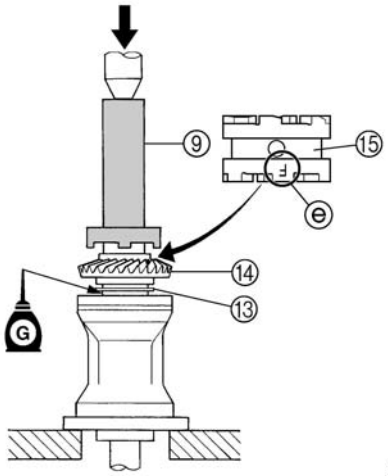
S6AL6420

Ring nut wrench ⑨: 90890-06578

Ring nut ⑫:
108 N·m (10.8 kgf·m, 79.7 ft·lb)

6

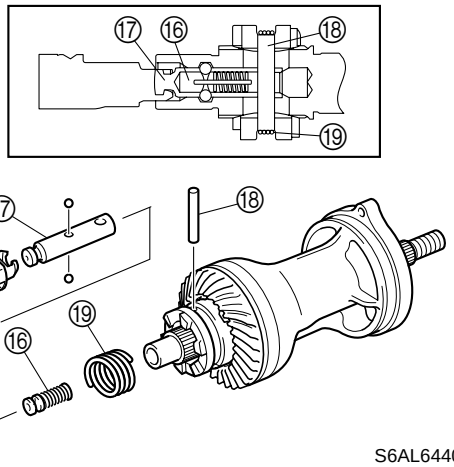
7. Install the original shim(s) ⑬, forward gear ⑭, and dog clutch ⑮ using a press.



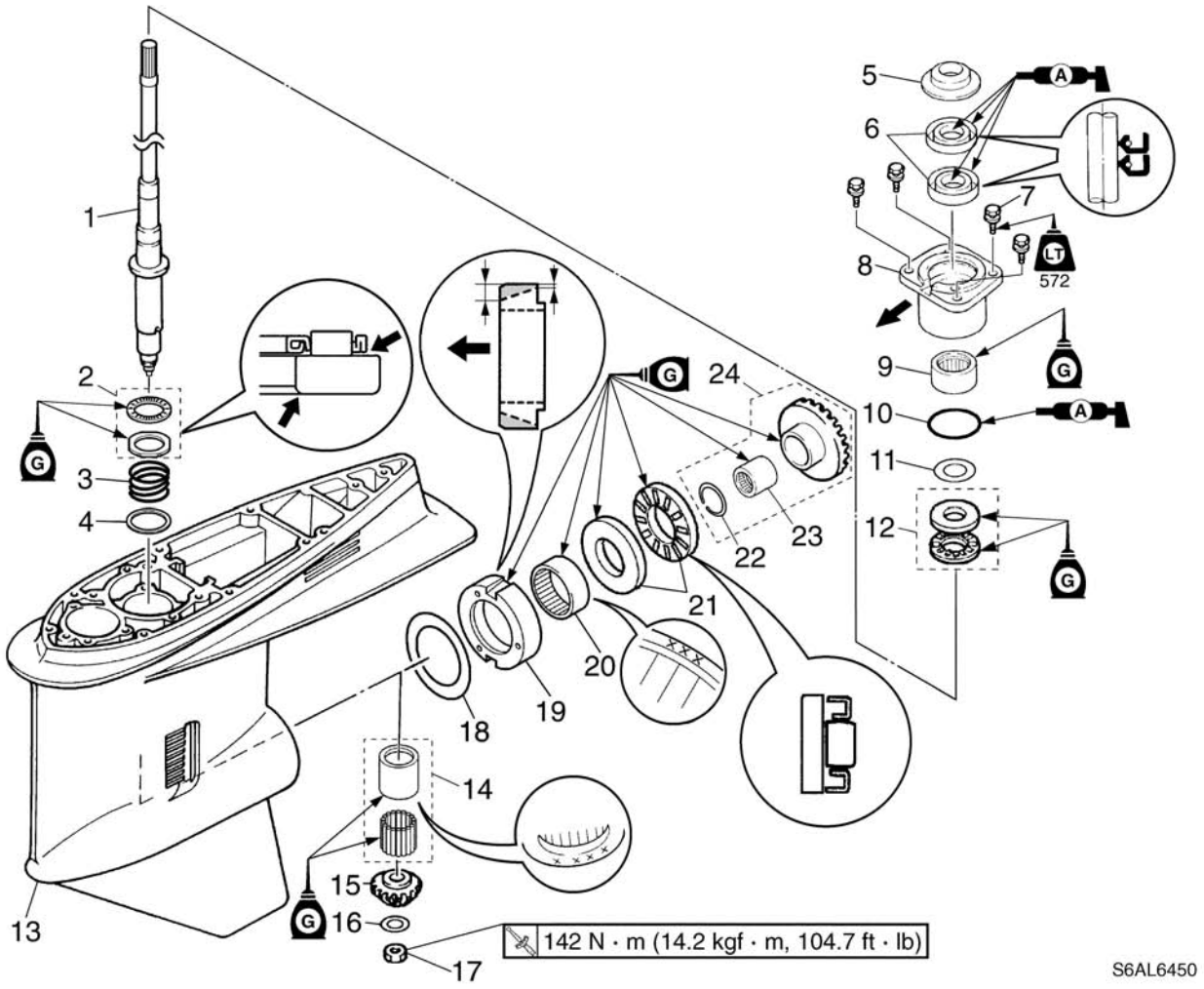
NOTE:
- Be sure to select the forward gear shim(s) if replacing the propeller shaft housing, taper roller bearing, or lower case.
- To select the shims, see Chapter 6, "Shimming (counter rotation model)."
- Install the dog clutch ⑮ with the "F" mark ⓔ facing toward the forward gear.
- After installing the forward gear, check that the propeller shaft and forward gear rotates smoothly.

Ring nut wrench ⑨: 90890-06578

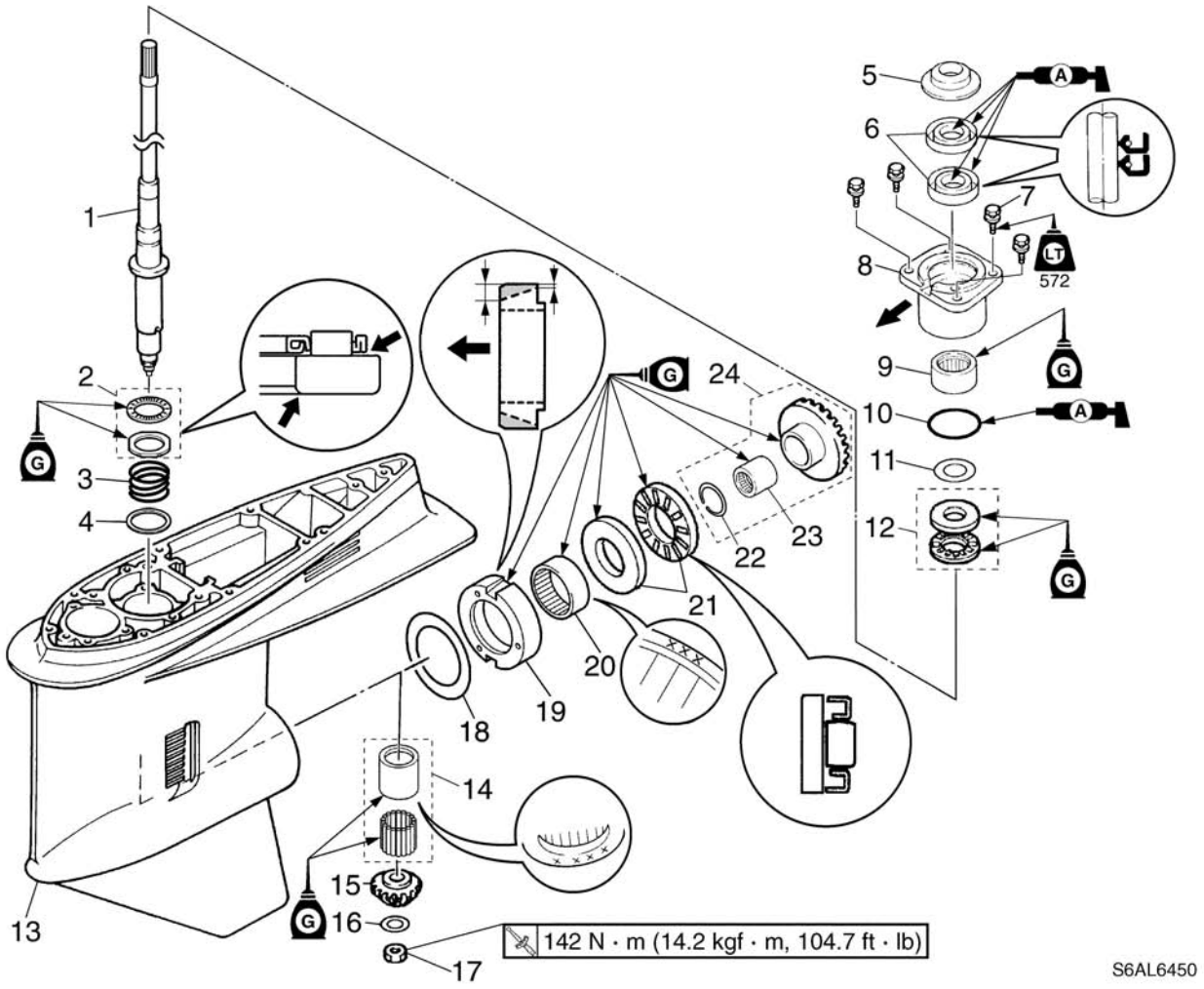
8. Install the shift plunger ⑯ and slider ⑰ into the propeller shaft, and then install the cross pin ⑱ and spring ⑲.



Drive shaft and lower case (counter rotation model)



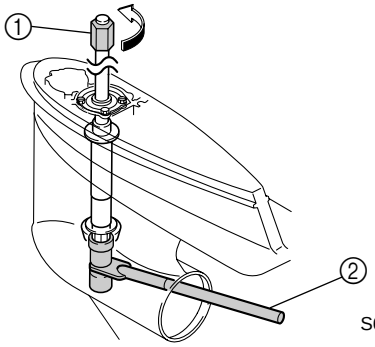
No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Thrust bearing	1	
3	Spring	1	
4	Washer	1	
5	Cover	1	
6	Oil seal	2	**Not reusable**
7	Bolt	4	M8 × 25 mm
8	Drive shaft housing	1	
9	Needle bearing	1	
10	O-ring	1	**Not reusable**
11	Pinion shim	—	
12	Thrust bearing	1	
13	Lower case	1	
14	Needle bearing	1	
15	Pinion	1	
16	Washer	1	
17	Nut	1	



No.	Part name	Q'ty	Remarks
18	Reverse gear shim	—	
19	Retainer	1	
20	Needle bearing	1	
21	Thrust bearing	1	
22	Circlip	1	**Not reusable**
23	Needle bearing	1	**Not reusable**
24	Reverse gear	1	

Removing the drive shaft

1. Remove the pinion nut.



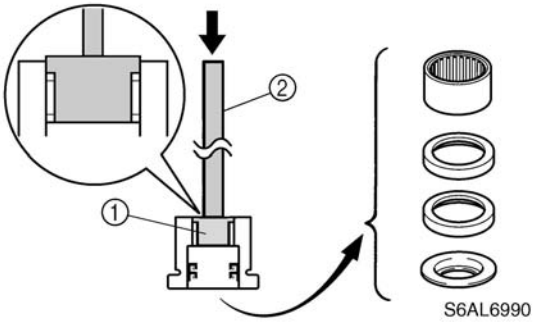
Drive shaft holder 6 ①: 90890-06520
Pinion nut holder ②: 90890-06715

2. Remove the drive shaft, drive shaft housing, pinion, thrust bearing, spring and washer.

3. Remove the reverse gear.

Disassembling the drive shaft housing

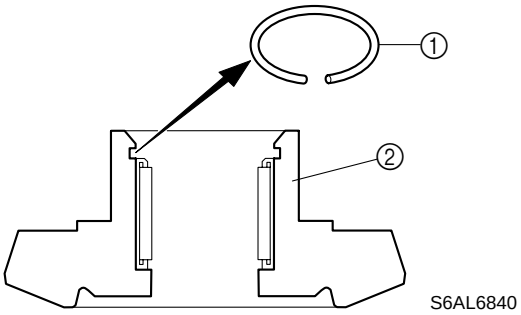
1. Remove the cover, oil seals, and needle bearing.



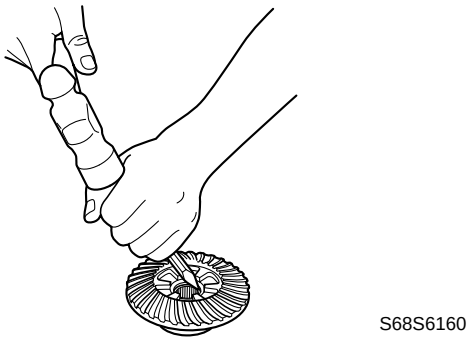
Needle bearing attachment ①:
90890-06610
Driver rod L3 ②: 90890-06652

Disassembling the reverse gear

1. Remove the circlip ① from the reverse gear ②.



2. Remove the needle bearing from the reverse gear using a chisel.



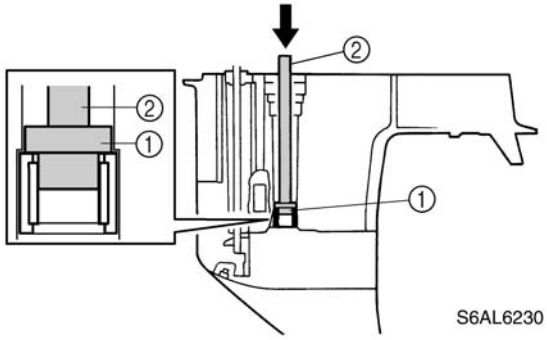
CAUTION:

Do not reuse the bearing, always replace it with a new one.

6

Disassembling the lower case

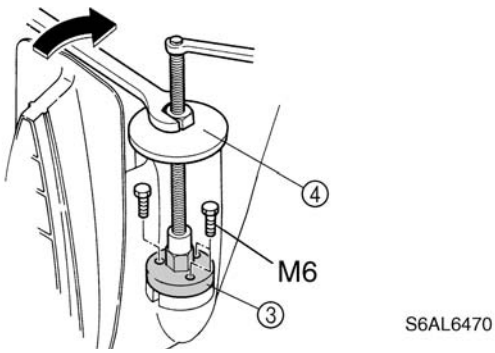
1. Remove the needle bearing from the lower case.



NOTE:
- Since the diameter of the passage in the lower case and the diameter of the special service tool ① are both 40 mm (1.57 in), the special service tool may not fit into the lower case. In that case, use a special service tool with a smaller diameter.
- Be sure to remove the reverse gear before removing the needle bearing.

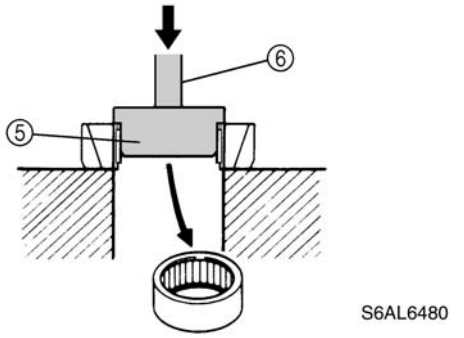
Ball bearing attachment ①: 90890-06655
Driver rod LL ②: 90890-06605

2. Remove the retainer and shim(s).



Flywheel puller ③: 90890-06521
Bearing outer race puller assembly ④: 90890-06523

3. Remove the needle bearing from the retainer.



Needle bearing attachment ⑤: 90890-06654
Driver rod L3 ⑥: 90890-06652

Checking the pinion and reverse gear

1. Check the teeth of the pinion, and the teeth and dogs of the reverse gear. Replace the pinion or reverse gear if cracked or worn.

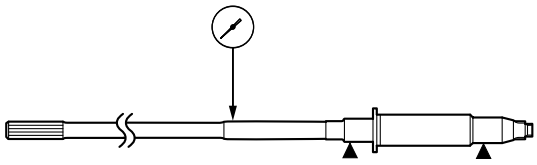
Checking the bearing

1. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the drive shaft

1. Check the drive shaft. Replace the drive shaft if bent or worn.

2. Measure the drive shaft runout. Replace the drive shaft if above specification.



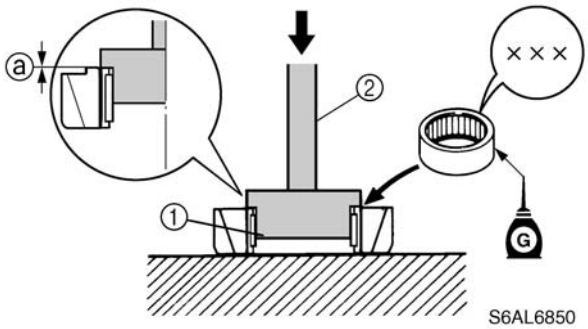
Drive shaft runout limit: 0.2 mm (0.008 in)

Checking the lower case

1. Check the skeg, torpedo, and anti-cavitation plate. Replace the lower case if cracked or damaged.

Assembling the lower case

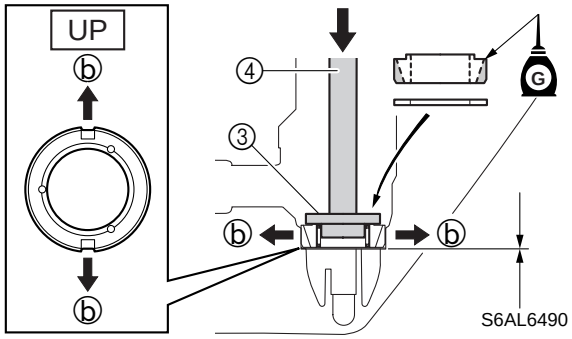
1. Install the needle bearing into the retainer to the specified depth.



Needle bearing attachment ①: 90890-06654
Driver rod L3 ②: 90890-06652

Depth ⓐ: 0 ± 0.25 mm (0 ± 0.01 in)

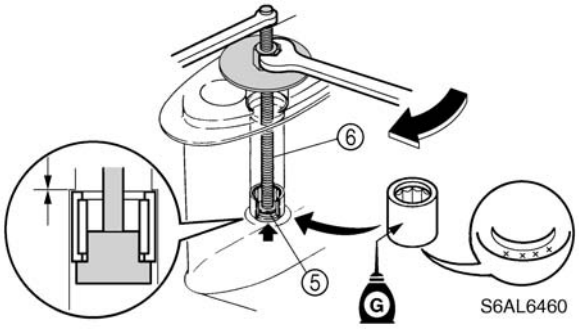
2. Install the original shim(s) and retainer into the lower case.



NOTE:
- Be sure to select the reverse gear shim(s) if replacing the thrust bearing, retainer or lower case.
- To select the shims, see Chapter 6, "Shimming (counter rotation model)."
- Make sure that the slots ⓑ in the retainer are aligned vertically as shown.

Ball bearing attachment ③: 90890-06657
Driver rod LL ④: 90890-06605

3. Install the needle bearing into the lower case.

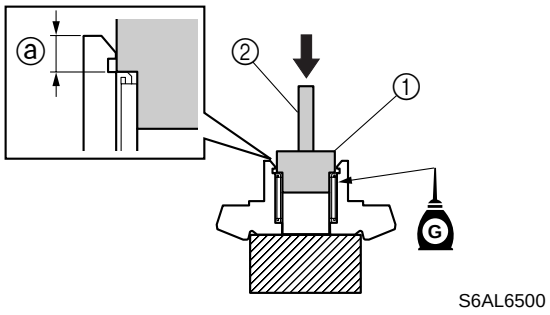


NOTE:
- Apply gear oil to the needle bearing outer case before installation.
- The needle bearing contains 24 rollers.

Ball bearing attachment ⑤: 90890-06655
Bearing outer race puller assembly ⑥: 90890-06523

Assembling the reverse gear

1. Install a new needle bearing into the reverse gear to the specified depth.

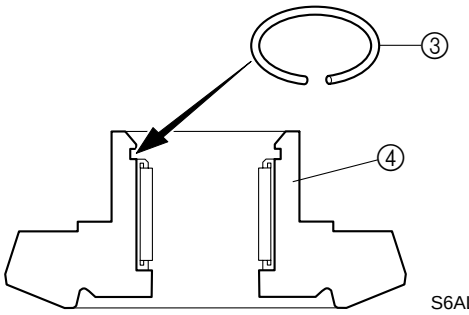


Needle bearing attachment ①: 90890-06653
Driver rod SS ②: 90890-06604

Depth ⓐ: 7 ± 0.25 mm (0.28 ± 0.01 in)

6

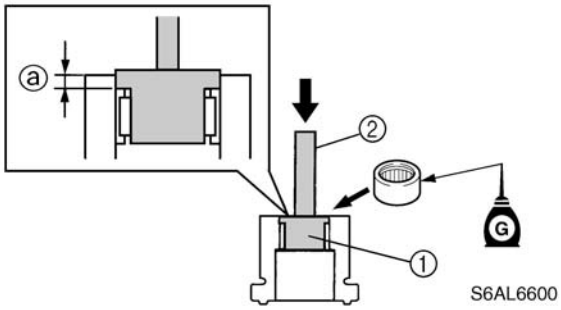
2. Install a new circlip ③ into the reverse gear ④.



S6AL6860

Assembling the drive shaft housing

1. Install the needle bearing into the drive shaft housing to the specified depth.

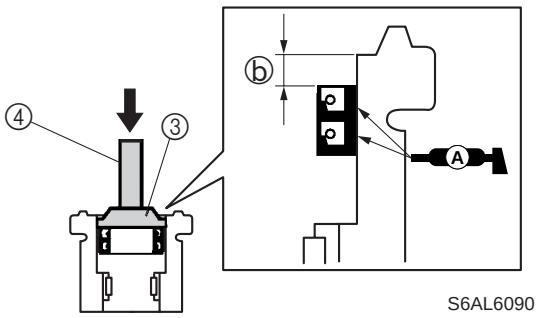


S6AL6600

Needle bearing attachment ①:
90890-06610
Driver rod SS ②: 90890-06604

Depth ⓐ:
4.5 ± 0.25 mm (0.18 ± 0.01 in)

2. Apply grease to new oil seals, and then install them into the drive shaft housing to the specified depth.



S6AL6090

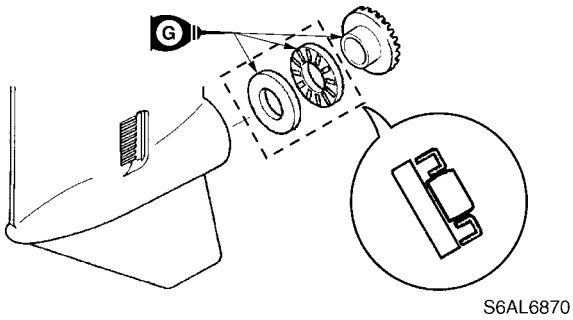
NOTE:
Install an oil seal halfway into the drive shaft housing, and then install the other oil seal.

Bearing outer race attachment ③:
90890-06628
Driver rod LS ④: 90890-06606

Depth ⓑ:
0.5 ± 0.25 mm (0.02 ± 0.01 in)

Installing the drive shaft

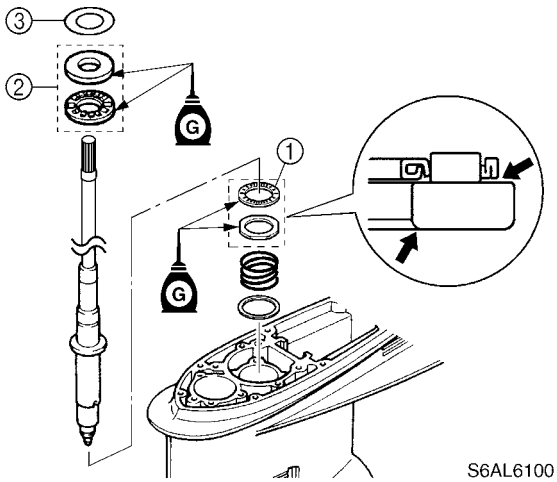
1. Install the thrust bearing and reverse gear into the lower case.



S6AL6870

2. Install the washer, spring, thrust bearing ①, drive shaft, thrust bearing ②, and original shim(s) ③ into the lower case.

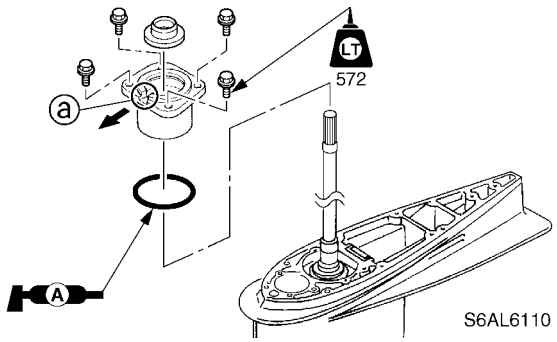
3. Install the pinion, washer, and pinion nut temporarily.



S6AL6100

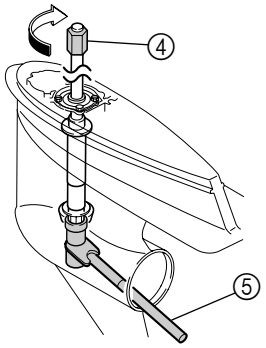
NOTE:
- Be sure to select the pinion shim(s) if replacing the thrust bearing ②, drive shaft housing, drive shaft, or lower case.
- To select the shims, see Chapter 6, "Shimming (counter rotation model)."
- To install the pinion nut, push down on the drive shaft.

4. Install a new O-ring to the drive shaft housing, and then install the drive shaft housing into the lower case.



NOTE:
Install the drive shaft housing with the cutout ⓐ in the housing facing forward as shown.

5. Tighten the pinion nut to the specified torque.



	Drive shaft holder 6 ④: 90890-06520 Pinion nut holder ⑤: 90890-06715

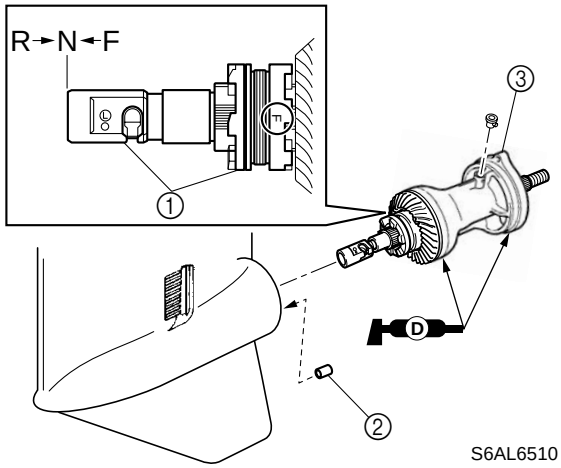
	Pinion nut: 142 N·m (14.2 kgf·m, 104.7 ft·lb)

Installing the propeller shaft housing

1. Set the shift rod joint and dog clutch ① to the neutral position as shown.

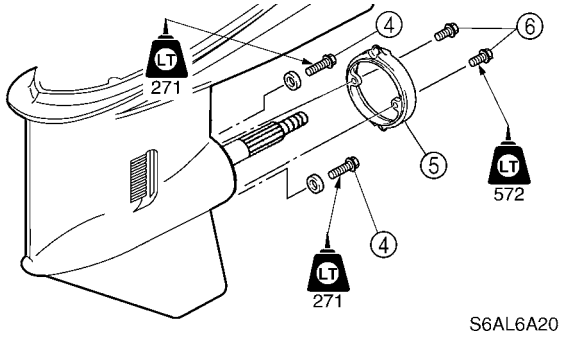
2. Apply grease to new O-rings and propeller shaft housing.

3. Install a new dowel ② and the propeller shaft housing assembly ③ into the lower case.



4. Install the washer and propeller shaft housing bolts ④, and then tighten the bolts to the specified torque.

5. Install the ring ⑤ and bolts ⑥.

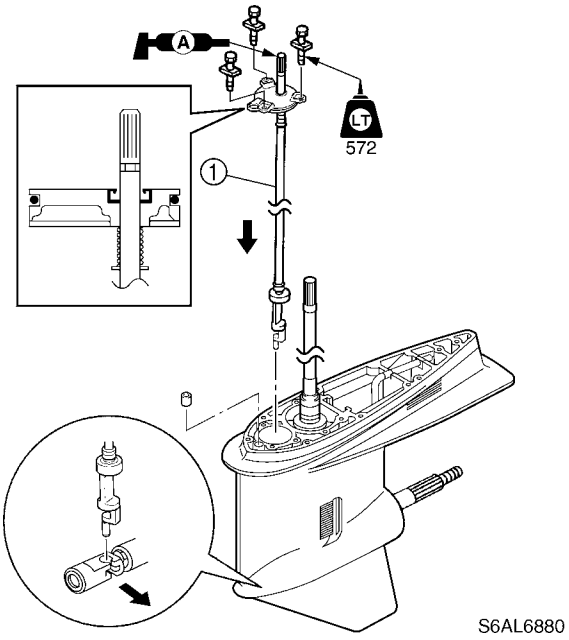


	Propeller shaft housing bolt ④: 30 N·m (3.0 kgf·m, 22.1 ft·lb)

6. Install the water pipe and rubber seals.

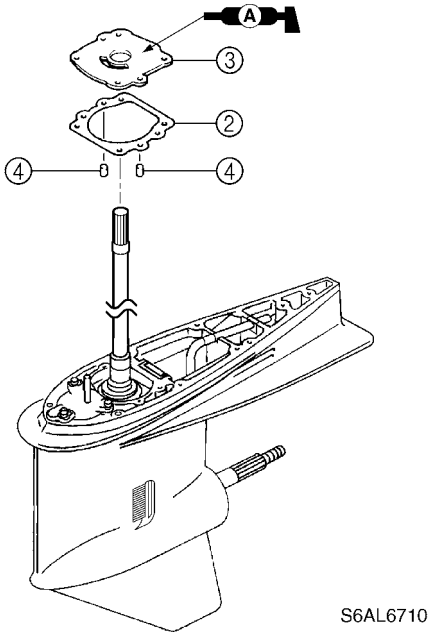
Installing the water pump and shift rod

1. Install the shift rod assembly ①.



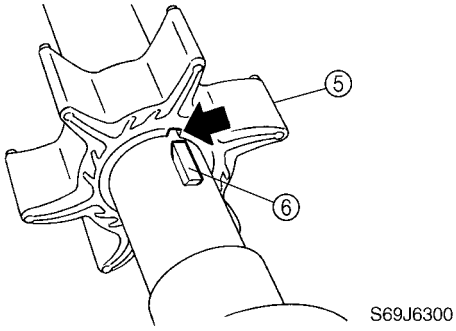
NOTE:
- Set the gear shift to the neutral position when installing the shift rod.
- After assembling the lower unit, check that the shift rod operates smoothly, and check that the drive shaft and propeller shaft rotate smoothly.
- When measuring the backlash, be sure to measure it before installing the water pump. To measure the backlash, see Chapter 6, "Measuring the forward and reverse gear backlash (counter rotation model)."

2. Install a new gasket ②, the outer plate cartridge ③, and dowels ④.

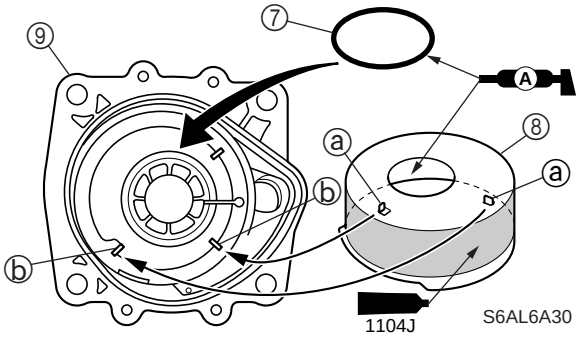


3. Install the Woodruff key ⑥ into the drive shaft.

4. Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.

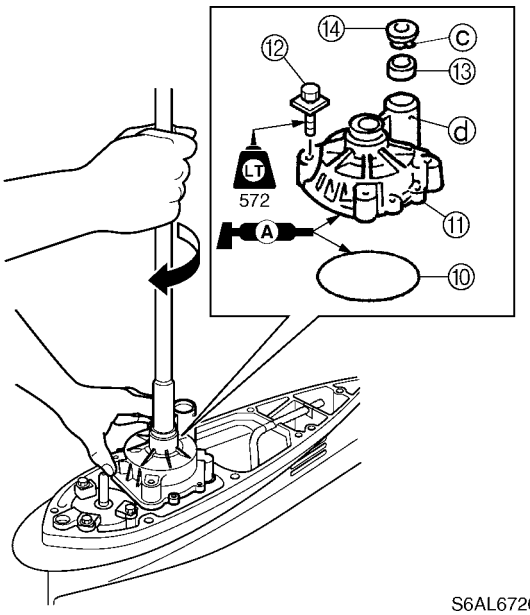


5. Install a new O-ring ⑦ and the insert cartridge ⑧ into the pump housing ⑨.



NOTE:
Align the insert cartridge projections ⓐ with the holes ⓑ in the pump housing.

6. Install a new O-ring ⑩ and the pump housing assembly ⑪ into the lower case, tighten the bolts ⑫, and then install the seal ⑬ and cover ⑭.



S6AL6720

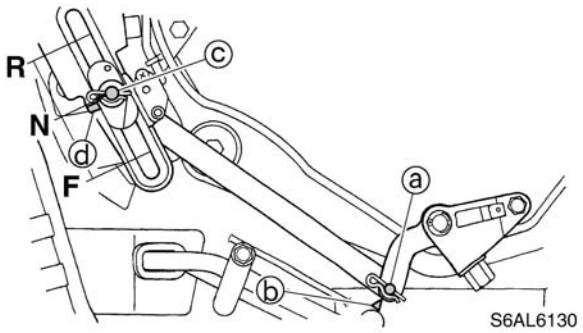
CAUTION:
Do not turn the drive shaft counterclockwise, otherwise the water pump impeller may be damaged.

NOTE:
- When installing the pump housing, apply grease to the inside of the insert cartridge, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⓒ with the hole ⓓ in the pump housing.

Installing the lower unit

⚠ WARNING
When installing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.

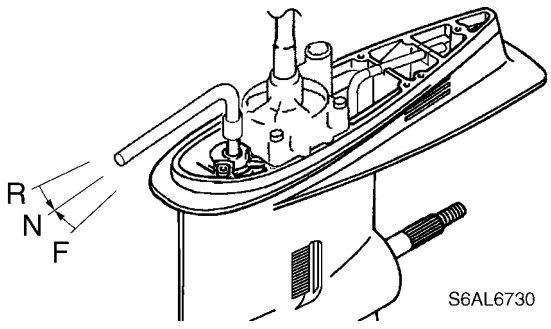
1. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bottom cowling to set the shift lever to the neutral position.



S6AL6130

NOTE:
If the power unit is installed, the set pin ⓐ and alignment mark ⓑ cannot be aligned, so align the set pin ⓒ with the alignment mark ⓓ on the shift bracket.

2. Set the gear shift to the neutral position at the lower unit.



S6AL6730

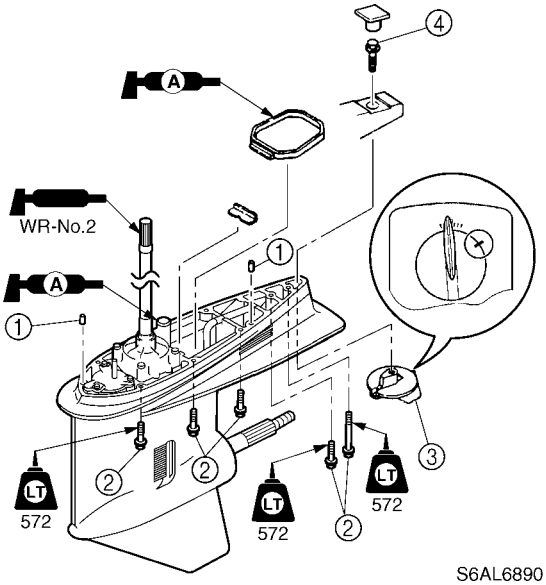
Shift rod push arm: 90890-06052

6

3. Install the dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.

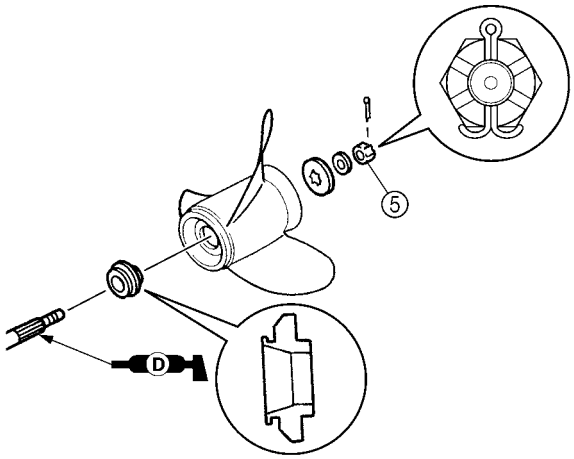
5. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.



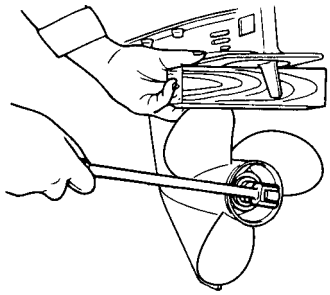
S6AL6890

	Lower case mounting bolt ②: 47 N·m (4.7 kgf·m, 34.7 ft·lb) Trim tab bolt ④: 42 N·m (4.2 kgf·m, 31.0 ft·lb)

6. Install the propeller and propeller nut, and then tighten the nut temporarily. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S6AL6A50


S69J6540

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.

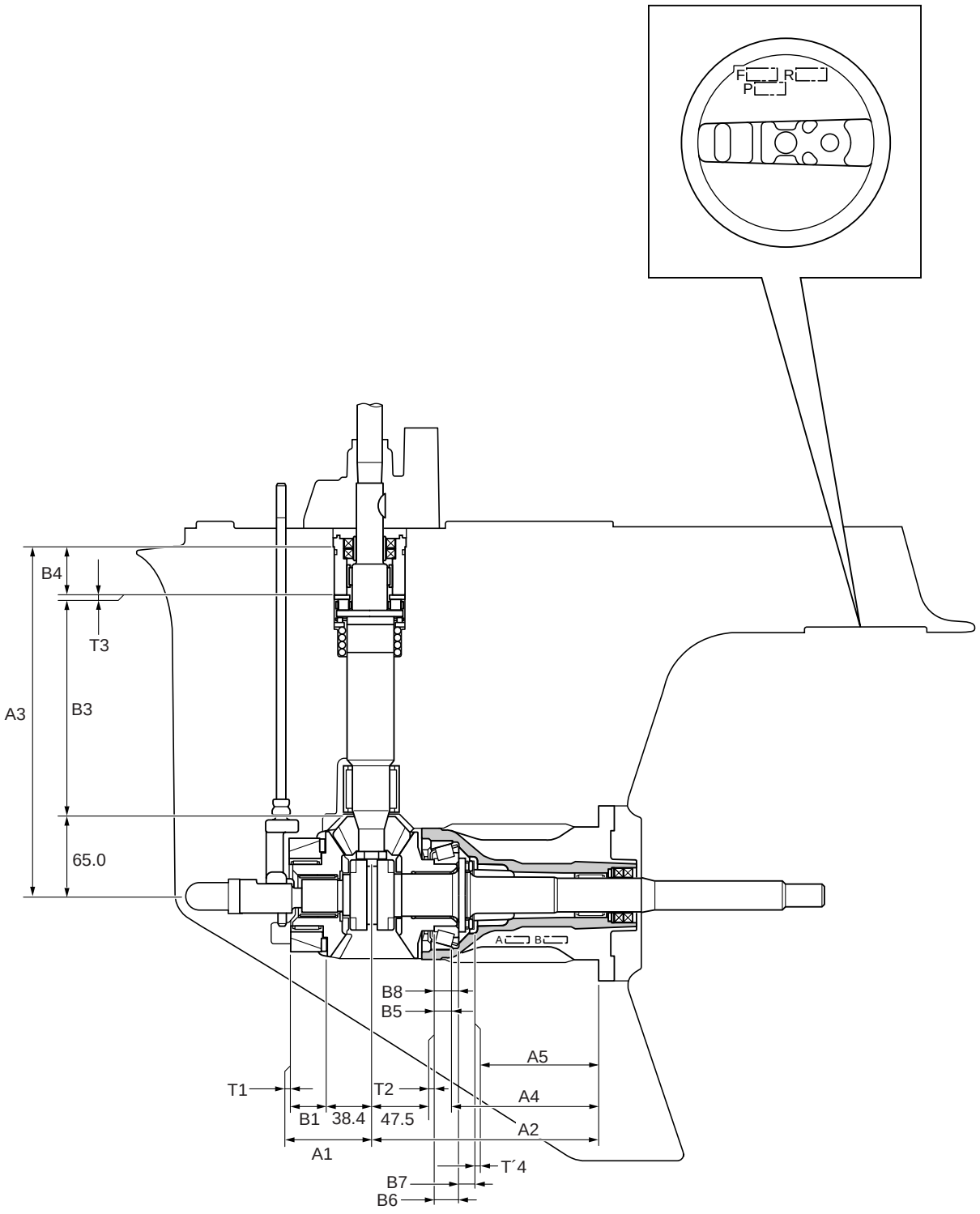
	Propeller nut ⑤: 54 N·m (5.4 kgf·m, 39.8 ft·lb)

7. Fill the gear oil to the correct level.



Recommended gear oil:
Hypoid gear oil
API: GL-4
SAE: 90
Gear oil quantity:
Counter rotation model:
1,000 cm^3
(33.8 US oz, 35.3 Imp oz)

Shimming (counter rotation model)



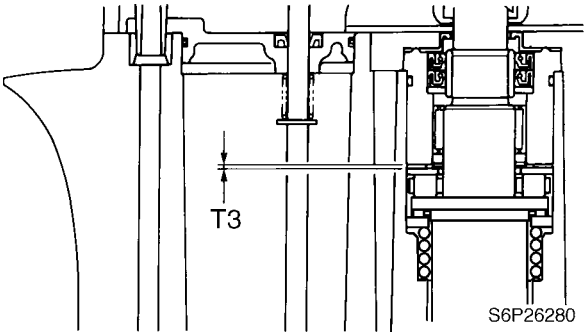
S6P26300

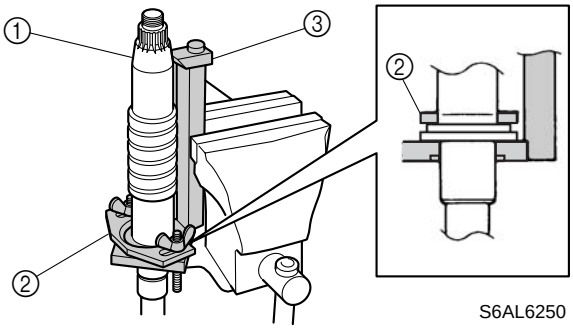
Shimming

NOTE:
- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shim

1. Install the special service tool onto the drive shaft ①.





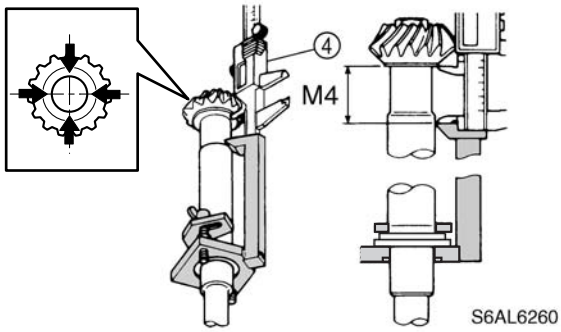
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Hold the special service tool ③ in a vise, and then install the drive shaft ① into the special service tool so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the plate ②.
- Make sure that the special service tool and drive shaft are parallel.

Pinion height gauge ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.

Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

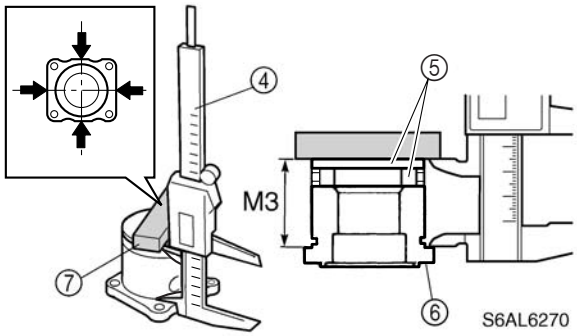
3. Measure the distance (M4) between the special service tool and the pinion as shown.



NOTE:
Measure the pinion at 4 points to find the distance average.

Digital caliper ④: 90890-06704

4. Turn the thrust bearing ⑤ 2 or 3 times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.

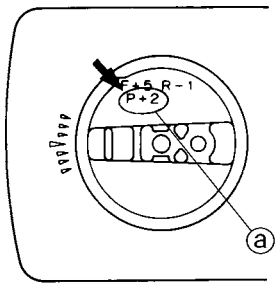


NOTE:
Measure the thrust bearing at 4 points to find the height average.

Digital caliper ④: 90890-06704
Shimming plate ⑦: 90890-06701

6

5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "P" mark is unreadable, assume that "P" is zero and check the backlash when the unit is assembled.

Calculation formula:
Pinion shim thickness (T3) =
82.00 + P/100 – M3 – M4

Example:
If "M3" is 50.75 mm, "M4" is 30.57 mm, and "P" is (+2), then
T3 = 82.00 + (+2)/100 – 50.75 – 30.57 mm
= 82.00 + 0.02 – 50.75 – 30.57 mm
= 0.70 mm
If "M3" is 50.70 mm, "M4" is 30.53 mm, and "P" is (–3), then
T3 = 82.00 + (–3)/100 – 50.70 – 30.53 mm
= 82.00 – 0.03 – 50.70 – 30.53 mm
= 0.74 mm

6. Select the pinion shim(s) (T3) as follows.

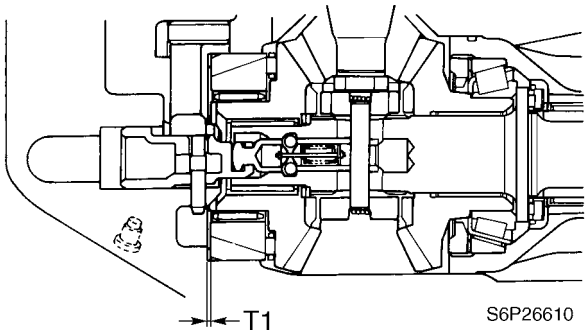
Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

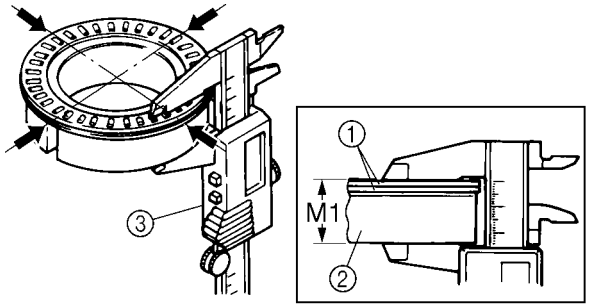
Example:
If "T3" is 0.70 mm, then the pinion shim is 0.68 mm.
If "T3" is 0.74 mm, then the pinion shim is 0.72 mm.

Selecting the reverse gear shim

1. Turn the thrust bearing ① 2 or 3 times to seat the bearing retainer ②, and then measure the bearing height (M1) as shown.



S6P26610

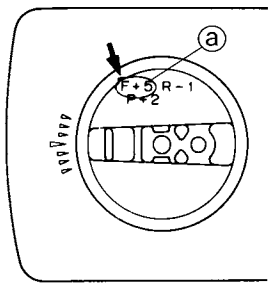


S6AL6520

NOTE:
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing retainer at 4 points to find the height average.

Digital caliper ③: 90890-06704

2. Calculate the reverse gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:

"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Calculation formula: Reverse gear shim thickness (T1) = 30.60 + F/100 – M1

Example:
If "M1" is 29.94 mm and "F" is (+5), then
T1 = 30.60 + (+5)/100 – 29.94 mm
= 30.60 + 0.05 – 29.94 mm
= 0.71 mm
If "M1" is 29.94 mm and "F" is (+4), then
T1 = 30.60 + (+4)/100 – 29.94 mm
= 30.60 + 0.04 – 29.94 mm
= 0.70 mm

3. Select the reverse gear shim(s) (T1) as follows.

Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

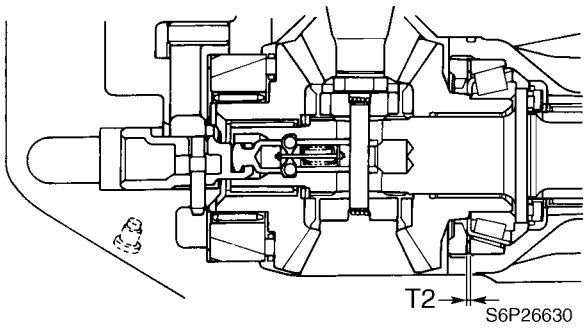
Available shim thicknesses: 0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Example:
If "T1" is 0.71 mm, then the reverse gear shim is 0.70 mm.
If "T1" is 0.70 mm, then the reverse gear shim is 0.68 mm.

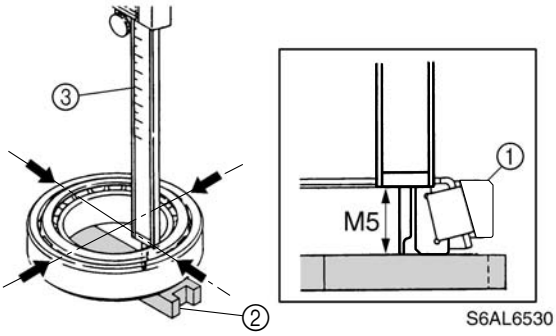
6

Selecting the forward gear shim

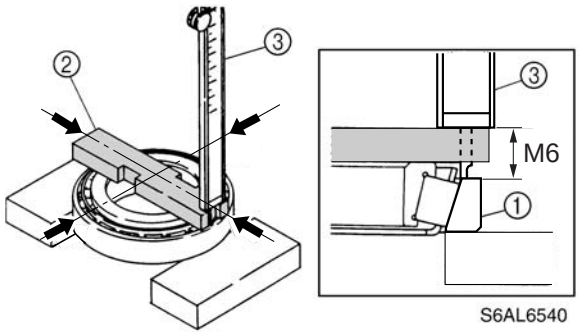
1. Turn the taper roller bearing outer race ① 2 or 3 times to seat the rollers, and then measure the bearing height (M5) and (M6) as shown.



S6P26630



S6AL6530

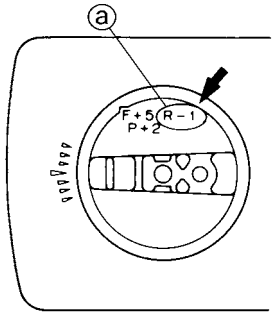


S6AL6540

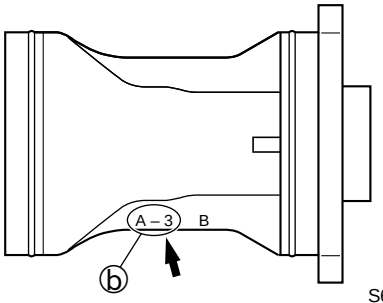
NOTE:
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at 4 points to find the height average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Calculate the forward gear shim thickness (T2) as shown in the examples below.



S69J6585



S6AL6750

NOTE:
"R" is the deviation of the lower case dimension from standard, and "A" is the deviation of the propeller shaft housing dimension from standard. The "R" mark ⓐ is stamped on the trim tab mounting surface of the lower case, and the "A" mark ⓑ is stamped on the propeller shaft housing in 0.01 mm units. If the "R" mark or "A" mark is unreadable, assume that "R" and "A" are zero and check the backlash when the unit is assembled.

Calculation formula:
Forward gear shim thickness (T2) =
8.45 + R/100 – A/100 – M5 + M6

Example:
If "M5" is 22.95 mm, "M6" is 15.73 mm, "R" is (–1), and "A" is (–3), then
T2 = 8.45 + (–1)/100 – (–3)/100 – 22.95 + 15.73 mm
= 8.45 – 0.01 + 0.03 – 22.95 + 15.73 mm
= 1.25 mm
If "M5" is 22.95 mm, "M6" is 15.73 mm, "R" is (–1), and "A" is (+2), then
T2 = 8.45 + (–1)/100 – (+2)/100 – 22.95 + 15.73 mm
= 8.45 – 0.01 – 0.02 – 22.95 + 15.73 mm
= 1.20 mm

3. Select the forward gear shim(s) (T2) as follows.

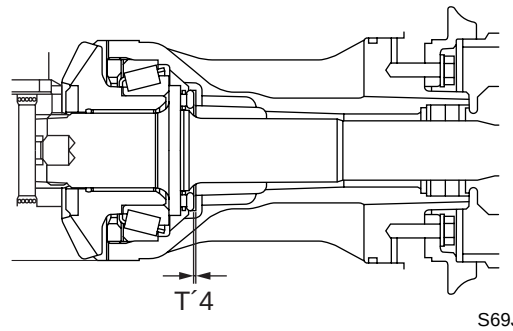
Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

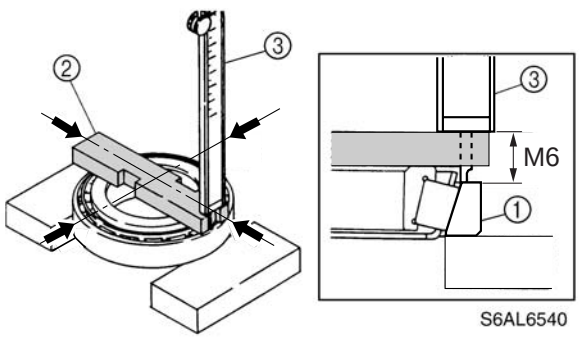
Example:
If "T2" is 1.25 mm, then the forward gear shim is 1.22 mm.
If "T2" is 1.20 mm, then the forward gear shim is 1.18 mm.

Selecting the propeller shaft shim

1. Turn the taper roller bearing outer race ① 2 or 3 times to seat the rollers, and then measure the bearing height (M6) as shown.



S69J6705

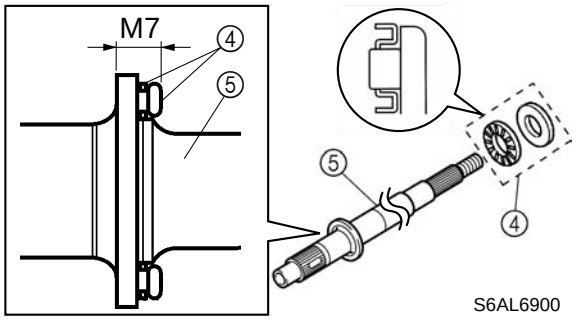


S6AL6540

NOTE:
- Select the shim thickness (T'4) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at 4 points to find the height average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

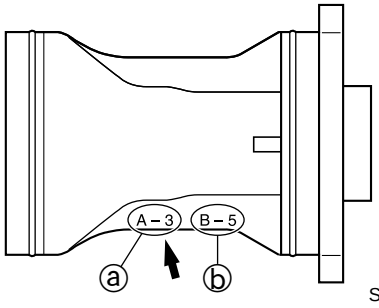
2. Install the thrust bearing ④ onto the propeller shaft ⑤, and then measure the propeller shaft flange and thrust bearing thickness (M7) as shown.



S6AL6900

6

3. Calculate the propeller shaft shim thickness (T'4) as shown in the examples below.



S6AL6910

NOTE:
"A" and "B" are the deviation of the propeller shaft housing dimension from standard. The "A" mark ⓐ and "B" mark ⓑ are stamped on the propeller shaft housing in 0.01 mm units. If the "A" mark or "B" mark is unreadable, assume that "A" and "B" are zero and check the free play when the unit is assembled.

Calculation formula:
Propeller shaft shim thickness (T'4) =
28.70 + A/100 – B/100 – M6 – M7

Example:
If "M6" is 15.73 mm, "M7" is 12.50 mm, "A" is (–3), and "B" is (–5), then
T'4 = 28.70 + (–3)/100 – (–5)/100 – 15.73 – 12.50 mm
= 28.70 – 0.03 + 0.05 – 15.73 – 12.50 mm
= 0.49 mm
If "M6" is 15.73 mm, "M7" is 12.50 mm, "A" is (+7), and "B" is (–6), then
T'4 = 28.70 + (+7)/100 – (–6)/100 – 15.73 – 12.50 mm
= 28.70 + 0.07 + 0.06 – 15.73 – 12.50 mm
= 0.60 mm

4. Round the numbers for the propeller shaft shim(s) (T'4) as follows.

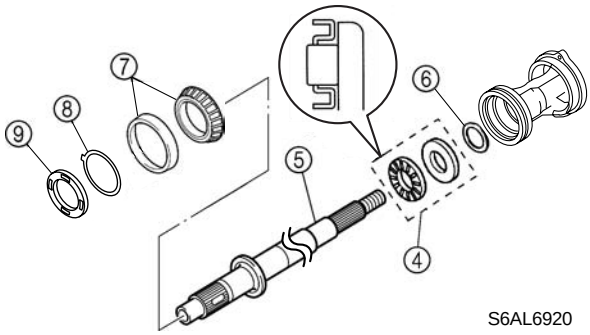
Calculated number at 1/100 place	Rounded number
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

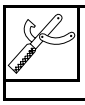
Example:
If "T'4" is 0.49 mm, then the propeller shaft shim is 0.48 mm.
If "T'4" is 0.60 mm, then the propeller shaft shim is 0.58 mm.

5. If the "A" mark or "B" mark is unreadable, measure the propeller shaft free play as shown.

6. Install the shim(s) ⑥, thrust bearing ④, propeller shaft ⑤, taper roller bearing ⑦, and claw washer ⑧, and then tighten the ring nut ⑨ to the specified torque.

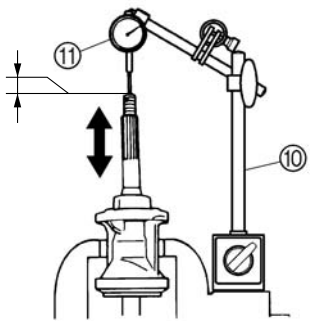


S6AL6920


Ring nut wrench: 90890-06578


Ring nut ⑨:
108 N·m (10.8 kgf·m, 79.7 ft·lb)

7. Measure the propeller shaft axial free play. Reselect the propeller shaft shim(s) (T'4) if out of specification.



S6AL6170

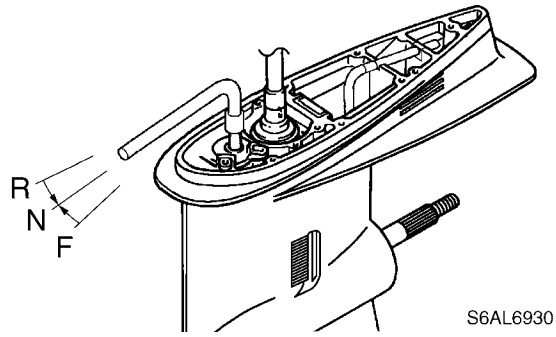
Magnet base B ⑩: 90890-06844
Dial gauge set ⑪: 90890-01252

Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)

Backlash (counter rotation model)

Measuring the forward and reverse gear backlash

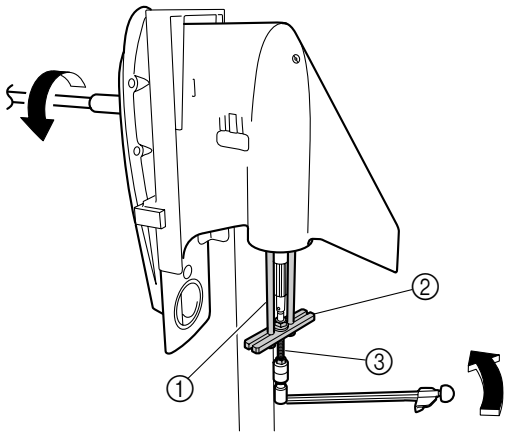
1. Install the lower unit onto a repair stand.
2. Remove the water pump assembly.
3. Set the gear shift to the neutral position at the lower unit.



S6AL6930

Shift rod push arm: 90890-06052

4. Turn the lower unit so that it is positioned as shown.
5. Install the special service tool.
6. Tighten the center bolt to the specified torque while turning the drive shaft.



S6AL6160

NOTE:
The drive shaft can no longer be turned when the center bolt is tightened to the specified torque.

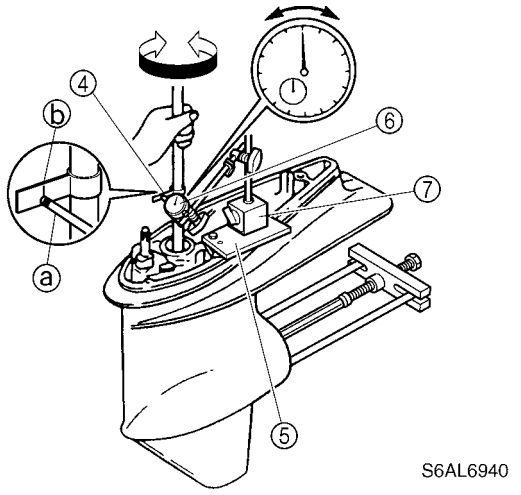
Bearing housing puller claw L ①: 90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

Center bolt ③:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

7. Turn the lower unit back to its original position.

6

8. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), and then install the dial gauge.



NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

9. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.

NOTE:
Measure the backlash at 4 points to find the average.

Forward gear backlash:
0.46–0.82 mm (0.0181–0.0323 in)

10. Add or remove shim(s) if out of specification.

Forward gear backlash	Shim thickness
Less than 0.46 mm (0.0181 in)	To be decreased by (0.64 – M) × 0.71
More than 0.82 mm (0.0323 in)	To be increased by (M – 0.64) × 0.71

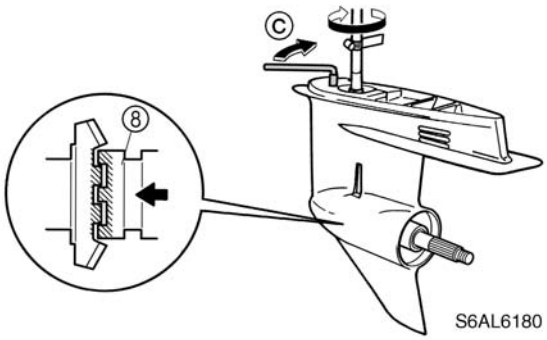
M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

11. Remove the special service tools from the propeller shaft.

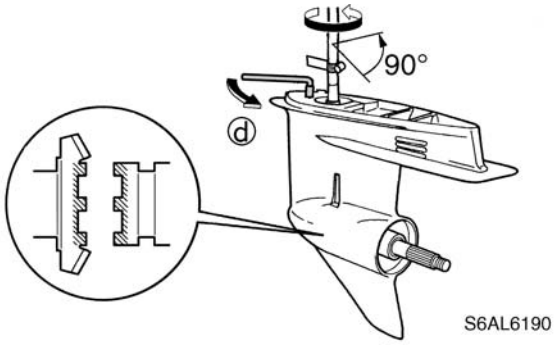
12. Turn the shift rod in direction ⓒ to the reverse position using the shift rod push arm.

13. Turn the drive shaft clockwise until the dog clutch ⑧ is fully engaged.



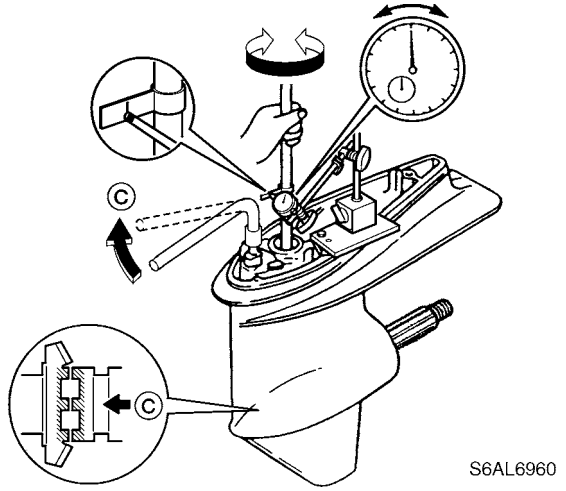
14. Turn the shift rod in direction ⓓ to the neutral position using the shift rod push arm.

15. Turn the drive shaft counterclockwise approximately 90°.



16. Turn the shift rod in direction Ⓒ to the reverse position using the shift rod push arm.

17. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



NOTE:
- When measuring the reverse gear backlash, add force to the reverse direction Ⓒ using the shift rod push arm.
- Measure the backlash at 4 points to find the average.

Reverse gear backlash:
0.45–0.90 mm (0.0177–0.0354 in)

18. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.45 mm (0.0177 in)	To be decreased by (0.68 – M) × 0.71
More than 0.90 mm (0.0354 in)	To be increased by (M – 0.68) × 0.71

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

19. Remove the special service tools, and then install the water pump assembly.

20. Fill the gear oil to the correct level.

Bracket unit

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Disassembling the shift bracket 7-6
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Assembling the bottom cowling 7-7

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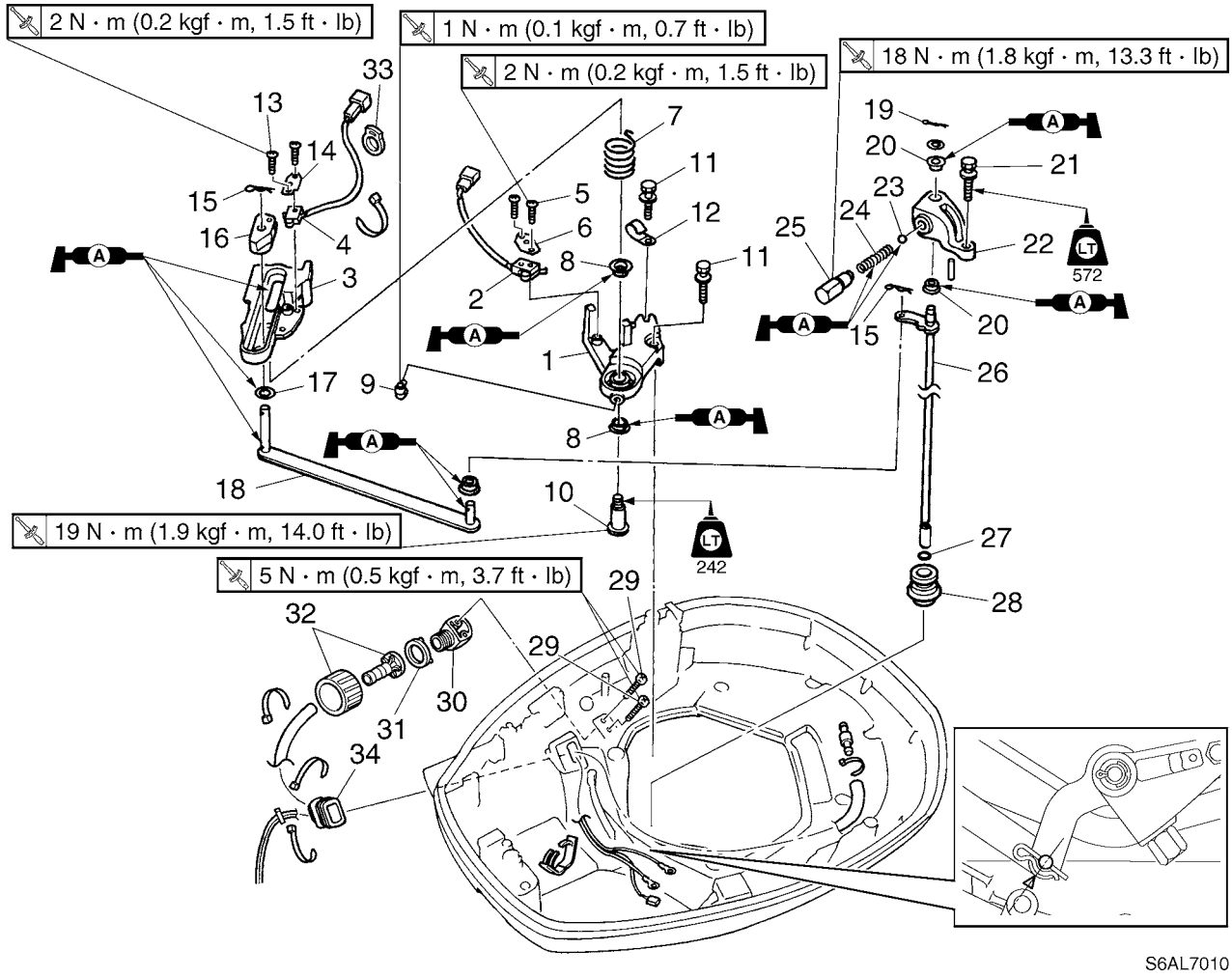
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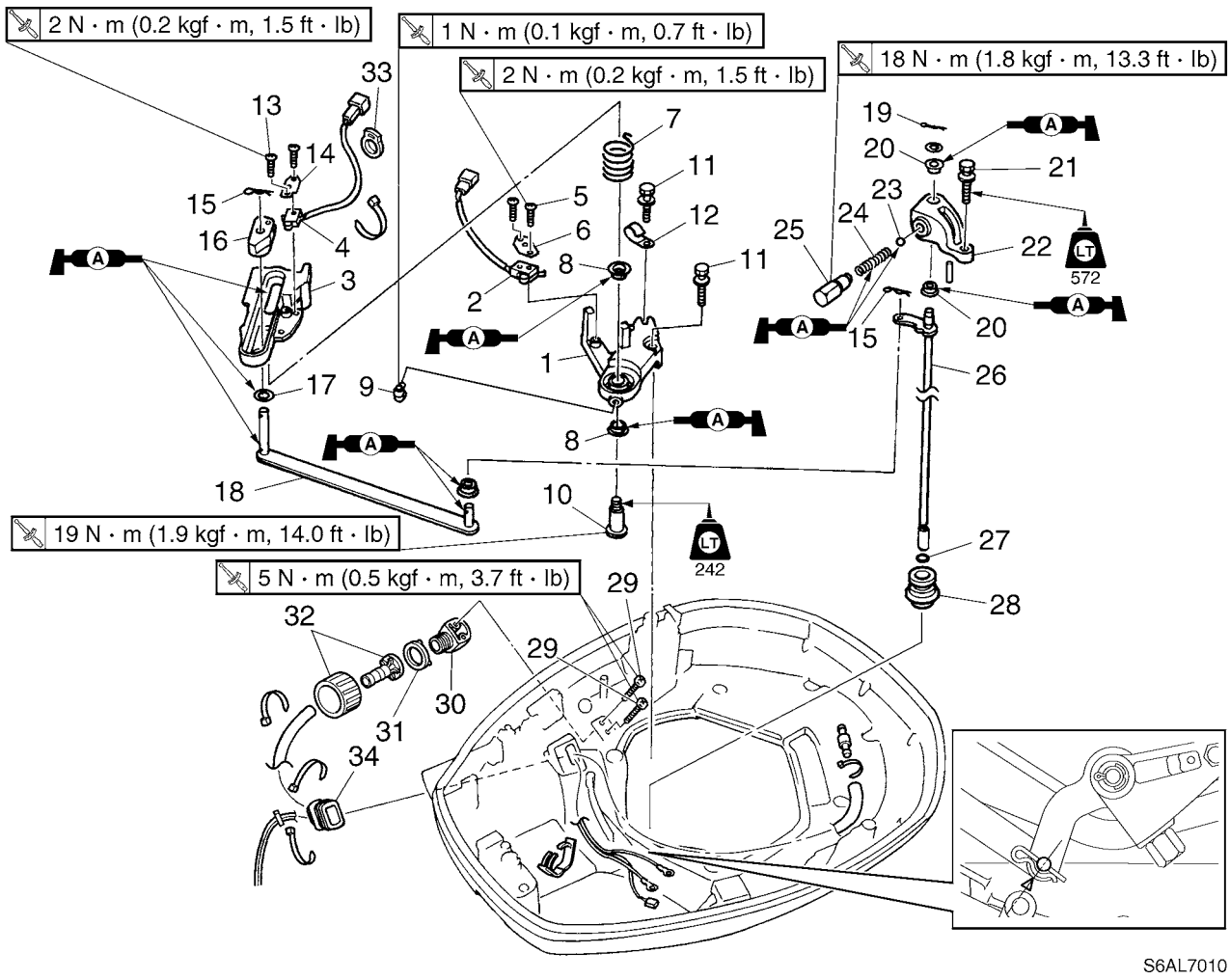
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7

Shift rod and bottom cowling

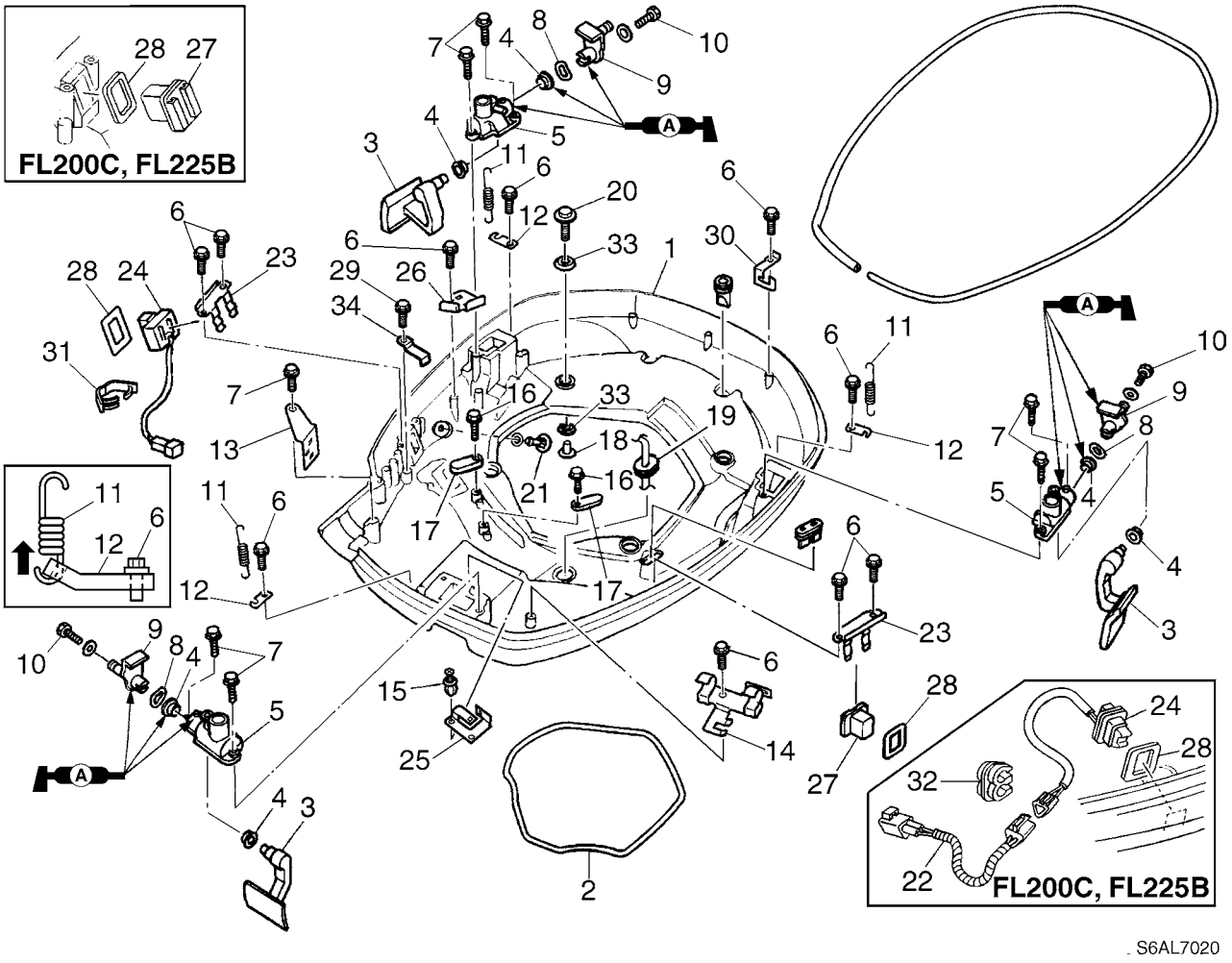


No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Shift cut switch	1	
3	Bracket	1	
4	Neutral switch	1	
5	Screw	2	ø4 × 16 mm
6	Plate	1	
7	Spring	1	
8	Bushing	2	
9	Grease nipple	1	
10	Shift bracket bolt	1	
11	Bolt	2	M6 × 35 mm
12	Clamp	1	
13	Screw	2	ø4 × 16 mm
14	Plate	1	
15	Clip	2	
16	Bushing	1	
17	Washer	1	

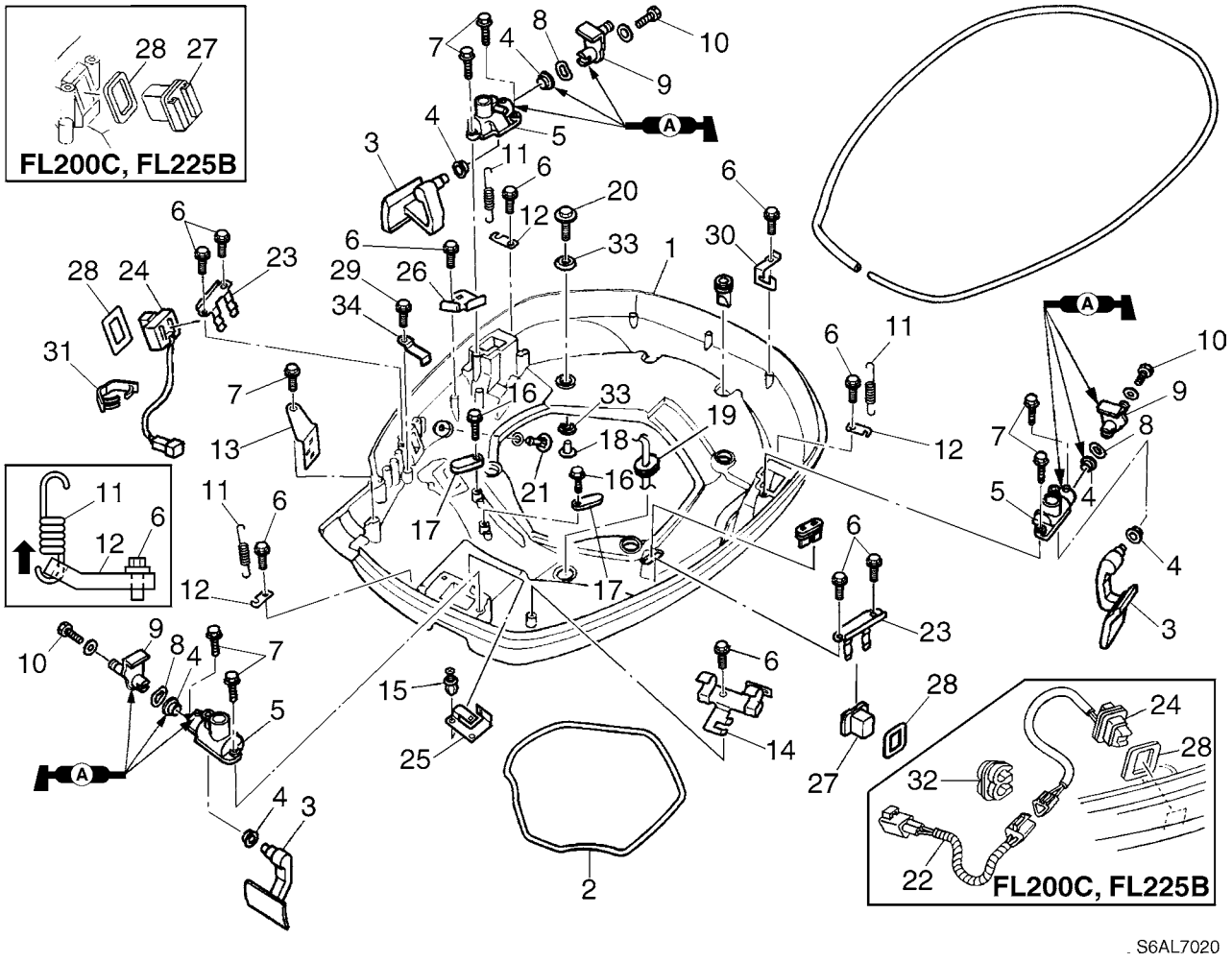


No.	Part name	Q'ty	Remarks
18	Shift lever	1	
19	Cotter pin	1	**Not reusable**
20	Bushing	2	
21	Bolt	1	M6 × 30 mm
22	Bracket	1	
23	Ball	1	
24	Spring	1	
25	Bolt	1	
26	Shift rod	1	
27	O-ring	1	**Not reusable**
28	Grommet	1	
29	Screw	2	ø6 × 20 mm
30	Flushing hose joint adapter	1	
31	Hose joint gasket	1	
32	Hose joint	1	
33	Clamp	1	
34	Grommet	1	

7



No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Cowling lock lever	3	
4	Bushing	6	
5	Plate	3	
6	Bolt	10	M6 × 20 mm
7	Bolt	7	M6 × 30 mm
8	Wave washer	3	
9	Lever	3	
10	Bolt	3	M6 × 20 mm
11	Spring	3	
12	Hook	3	
13	Bracket	1	
14	Bracket	1	
15	Rivet	2	
16	Bolt	2	M6 × 25 mm
17	Plate	2	

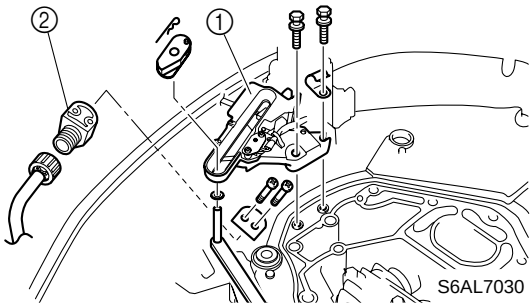


No.	Part name	Q'ty	Remarks
18	Collar	4	
19	Grommet	1	
20	Bolt	4	M8 × 35 mm
21	Cooling water pilot hole	1	
22	Wire lead extension	1	Counter rotation model
23	Holder	2	
24	PTT switch	1	
25	Bracket	1	
26	Bracket	1	
27	Cover	1	
28	Gasket	2	
29	Bolt	1	M6 × 20 mm/Regular rotation model
30	Bracket	1	
31	Clamp	1	
32	Holder	1	Counter rotation model
33	Grommet	8	
34	Holder	1	Regular rotation model

7

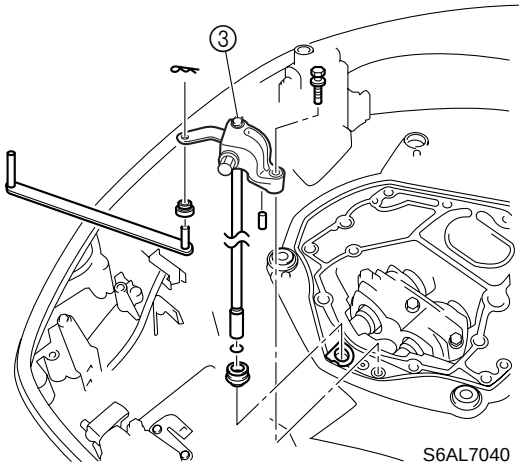
Disassembling the bottom cowling

1. Remove the shift bracket assembly ①, and then remove the flushing hose joint adapter ②.



NOTE:
- If the power unit is installed, remove the starboard intake manifold and dipstick guide, and then remove the shift bracket assembly ①.
- See the exploded diagrams (4-9, 5-33).

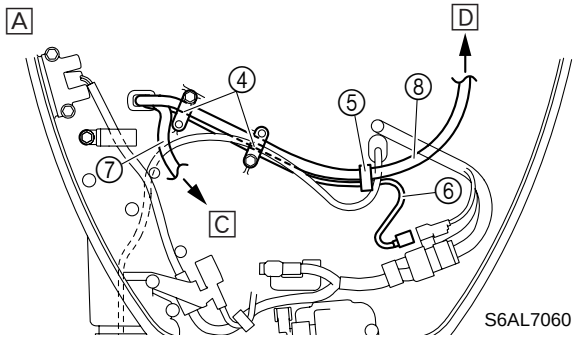
2. Remove the shift rod assembly ③.

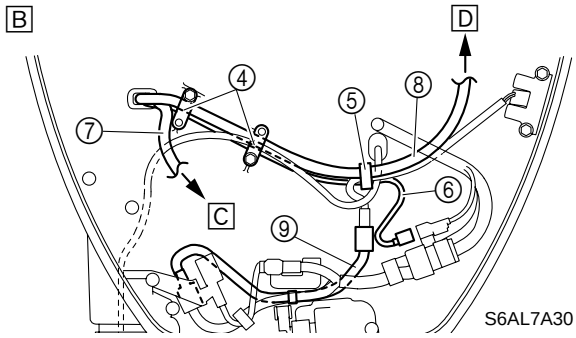


NOTE:
The shift rod assembly ③ cannot be removed when the power unit is installed.

3. Remove the plates ④ and clamp ⑤, and then pull out the trim sensor lead ⑥, PTT motor lead ⑦, and flushing hose ⑧.

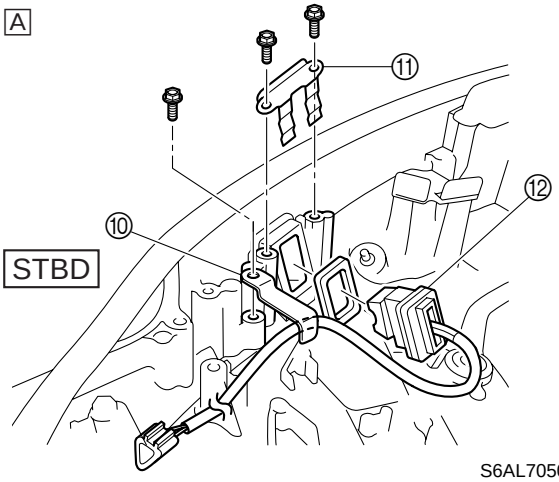
4. Remove the wire lead extension ⑨ (counter rotation model).

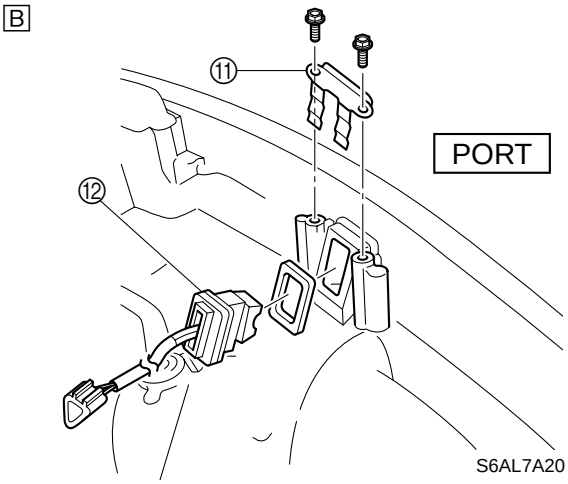




A Regular rotation model
B Counter rotation model
C To the PTT relay
D To the cooling water passage cover (via the joint)

5. Remove the holder ⑩ (regular rotation model) and holder ⑪, and then remove the PTT switch ⑫.



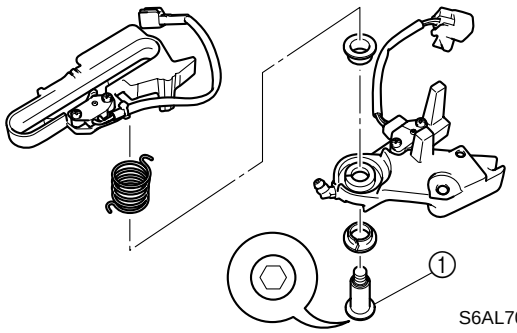


A Regular rotation model
B Counter rotation model

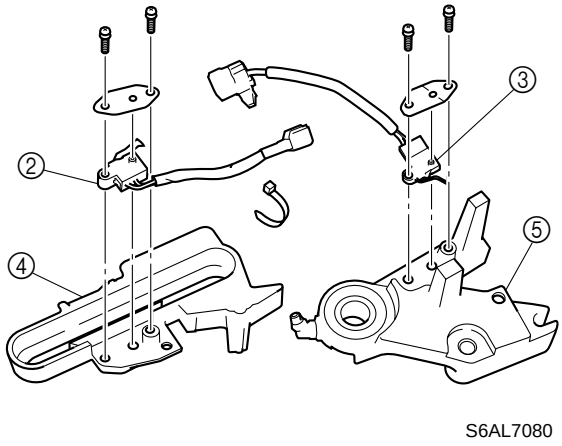
NOTE:
To check the PTT switch, see Chapter 7, "Checking the PTT switch."

Disassembling the shift bracket

1. Remove the bolt ①, and then disassemble the shift bracket assembly.



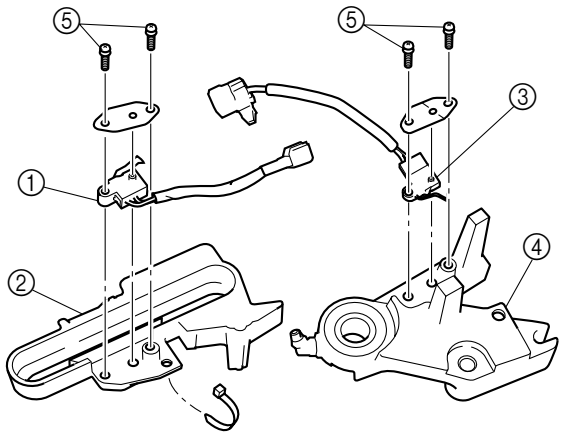
2. Remove the neutral switch ② and shift cut switch ③ from the brackets ④ and ⑤.



NOTE:
To check the neutral switch ② and shift cut switch ③, see Chapter 8, "Checking the neutral switch" and "Checking the shift cut switch."

Assembling the shift bracket

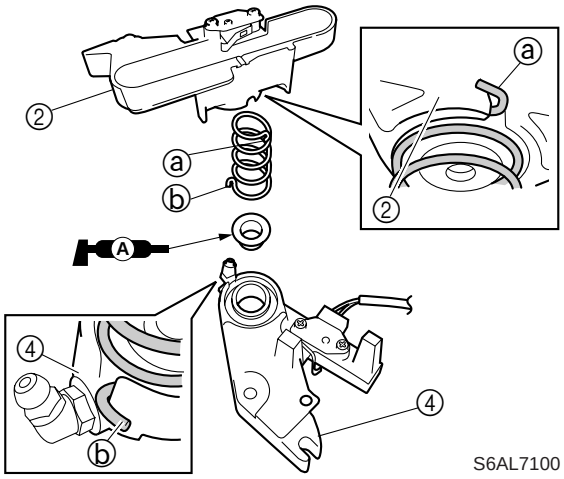
1. Install the neutral switch ① onto the bracket ② and the shift cut switch ③ onto the bracket ④.



	Neutral switch screw and shift cut switch screw ⑤: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

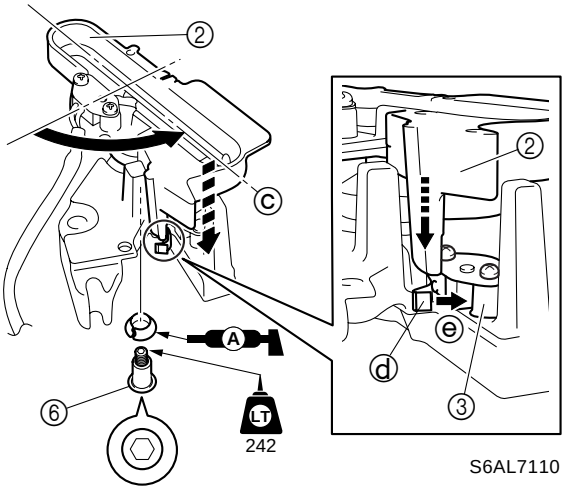
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2. Hook the spring end ⓐ into the cutout in the bracket ② and the spring end ⓑ into the cutout in the bracket ④.



3. Turn the bracket ② to the position ⓒ as shown, push it down, and then temporarily install the shift bracket bolt ⑥.

4. Tighten the shift bracket bolt ⑥ to the specified torque.



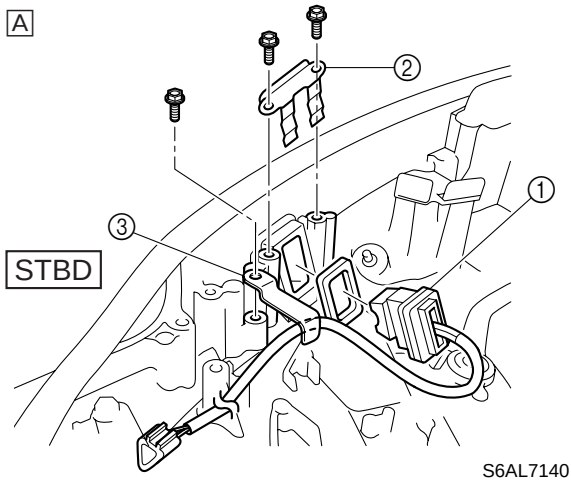
CAUTION:

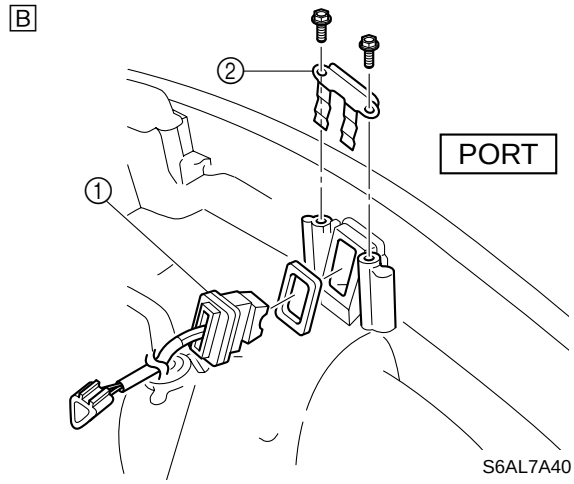
Move the shift cut switch lever ⓓ in direction ⓔ when pushing the shift bracket ② down, otherwise the lever may be damaged.

	Shift bracket bolt ⑥: 19 N·m (1.9 kgf·m, 14.0 ft·lb)

Assembling the bottom cowling

1. Install the PTT switch ①, holder ②, and holder ③ (regular rotation model).





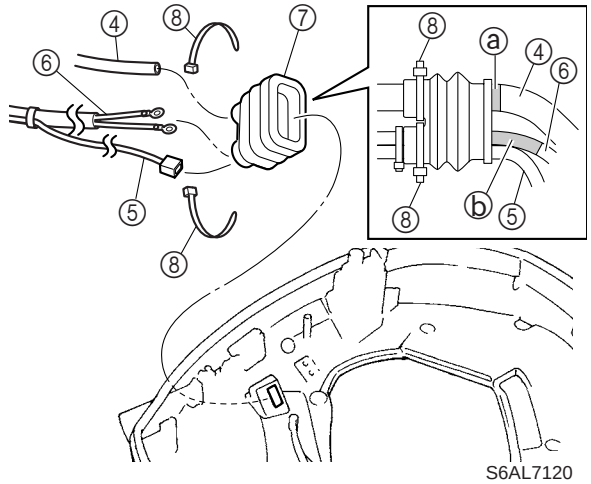
A Regular rotation model
B Counter rotation model

NOTE:

Fasten the PTT switch lead with the holder ③.

2. Pass the flushing hose ④, trim sensor lead ⑤, and PTT motor leads ⑥ through the grommet ⑦, and then secure them by fastening the plastic ties ⑧ around the grommet as shown.

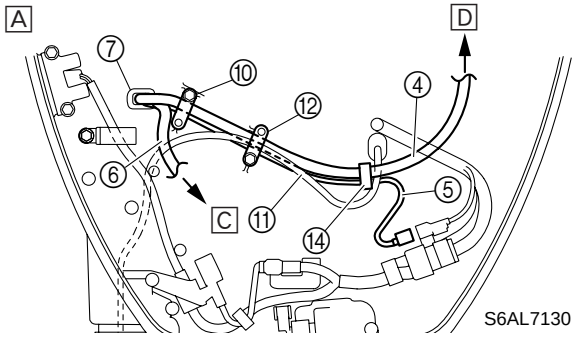
3. Install the grommet ⑦ to the bottom cowling.

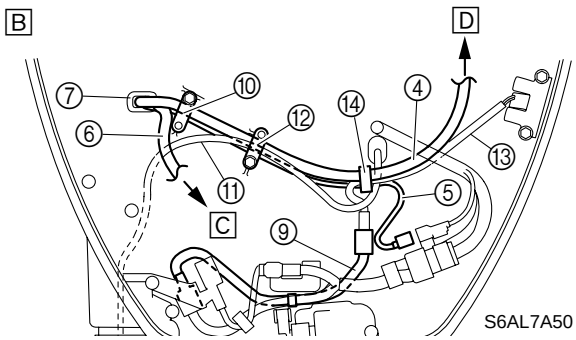


NOTE:
Make sure that the white paint mark ⓐ on the flushing hose ④ and the white tape ⓑ on the PTT motor leads ⑥ are positioned as shown.

4. Route the flushing hose ④, trim sensor lead ⑤, and PTT motor lead ⑥ as shown.

5. Install the wire lead extension ⑨ (counter rotation model).

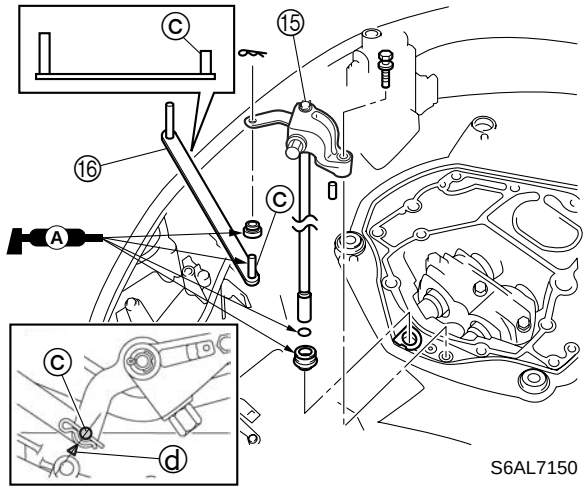




A Regular rotation model
B Counter rotation model
C To the PTT relay
D To the cooling water passage cover (via the joint)

NOTE:
- Fasten the flushing hose ④ and trim sensor lead ⑤ with the plate ⑩.
- Fasten the flushing hose ④, trim sensor lead ⑤, and speedometer hose ⑪ with the plate ⑫.
- Fasten the flushing hose ④, trim sensor lead ⑤, and PTT switch lead ⑬ (counter rotation model) with the clamp ⑭.

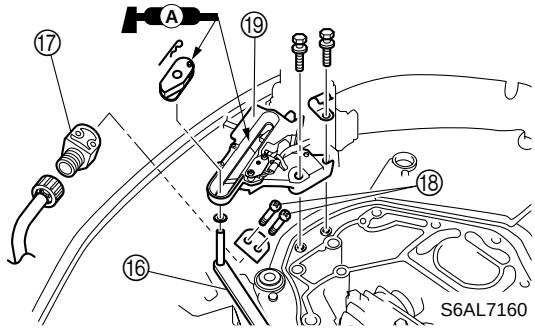
6. Install the shift rod assembly ⑮, and then align the center of the set pin ⓒ with the mark ⓓ on the bottom cowling.



NOTE:
- Be sure to install the shift rod assembly onto the bottom cowling before installing the power unit.
- Install the shorter set pin ⓒ of the shift lever ⑯ to the shift rod assembly.

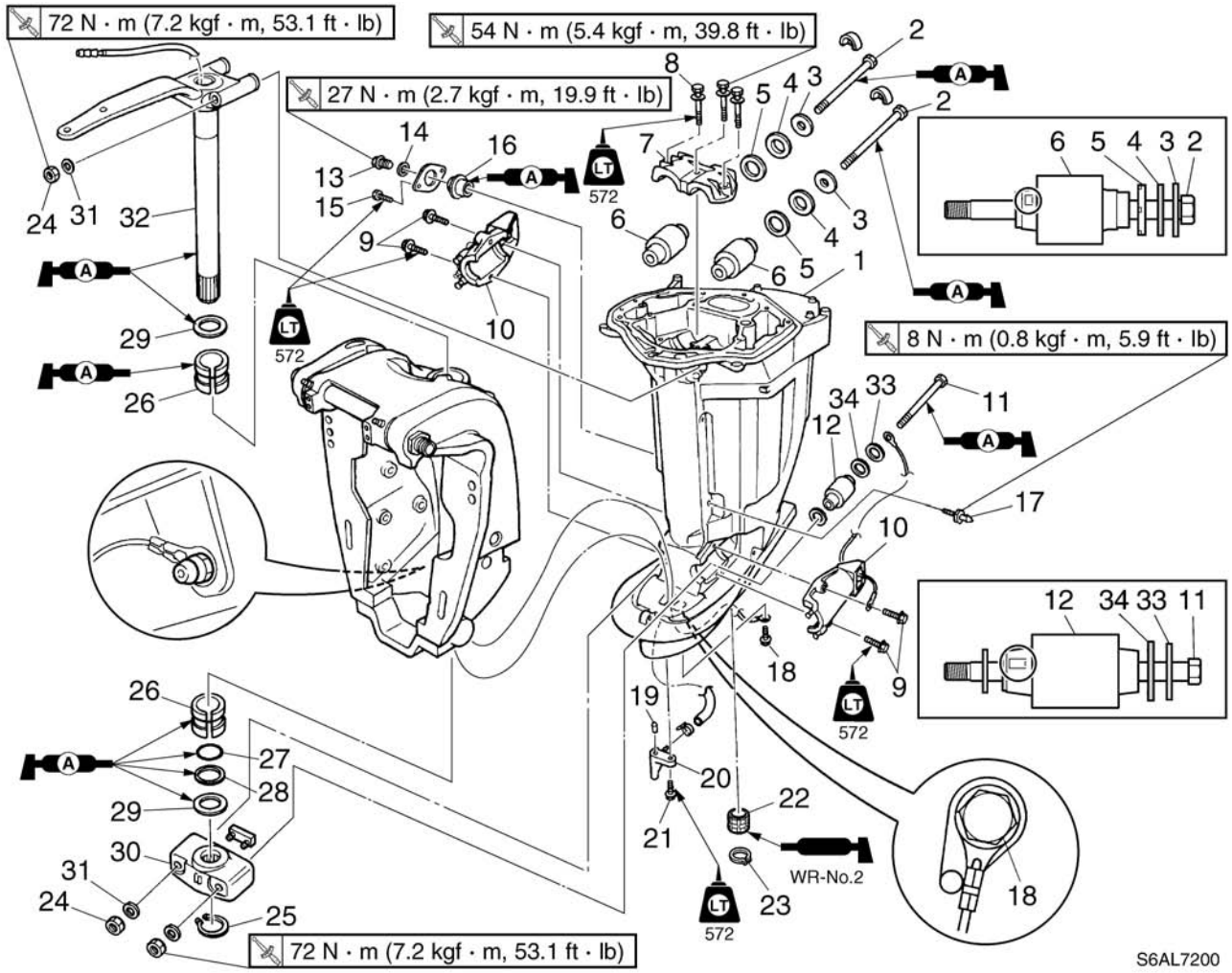
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7. Install the flushing hose joint adapter ⑰ and screws ⑱, and then install the shift bracket assembly ⑲.



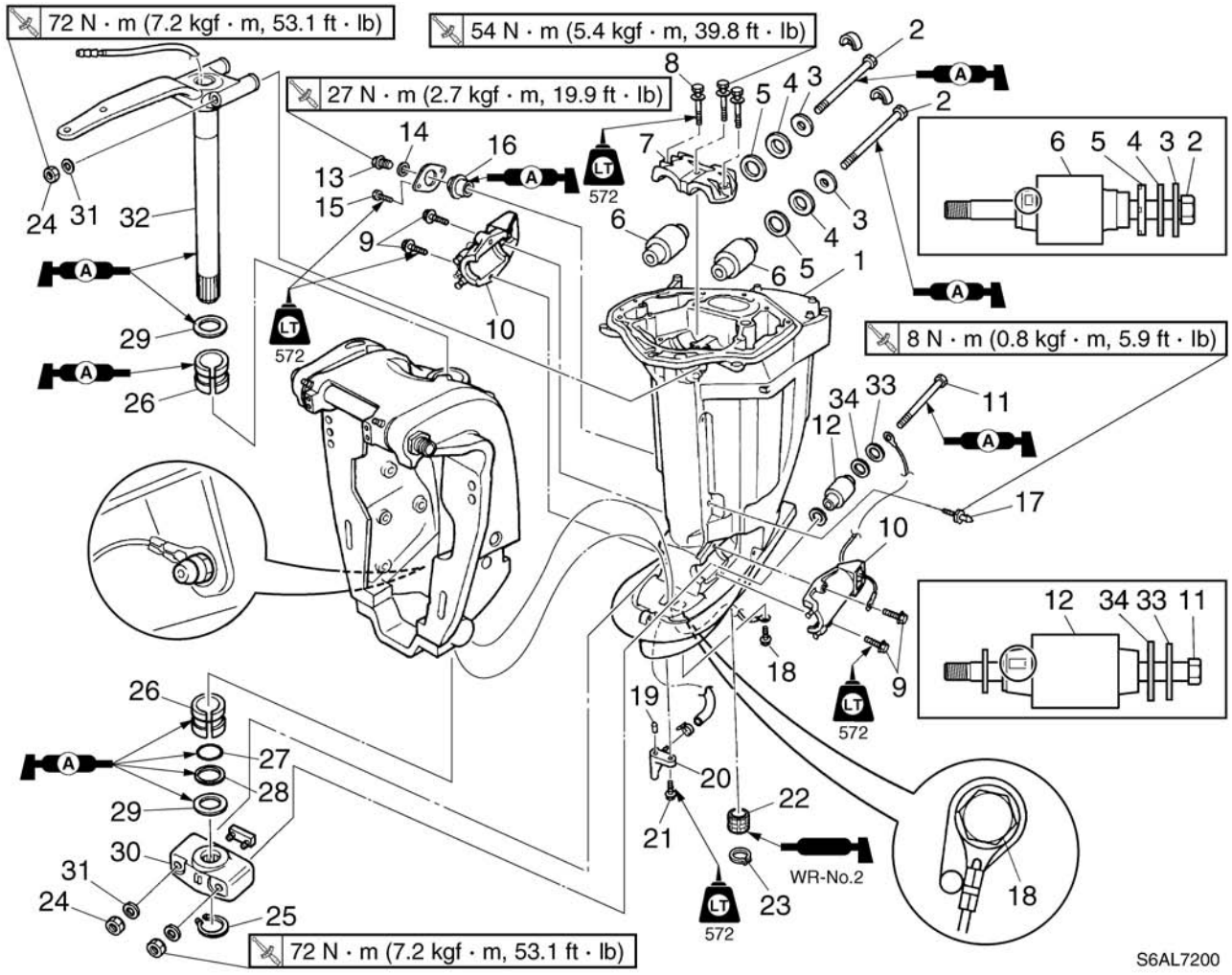
Hose joint adapter screw ⑱:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

Upper case and steering arm

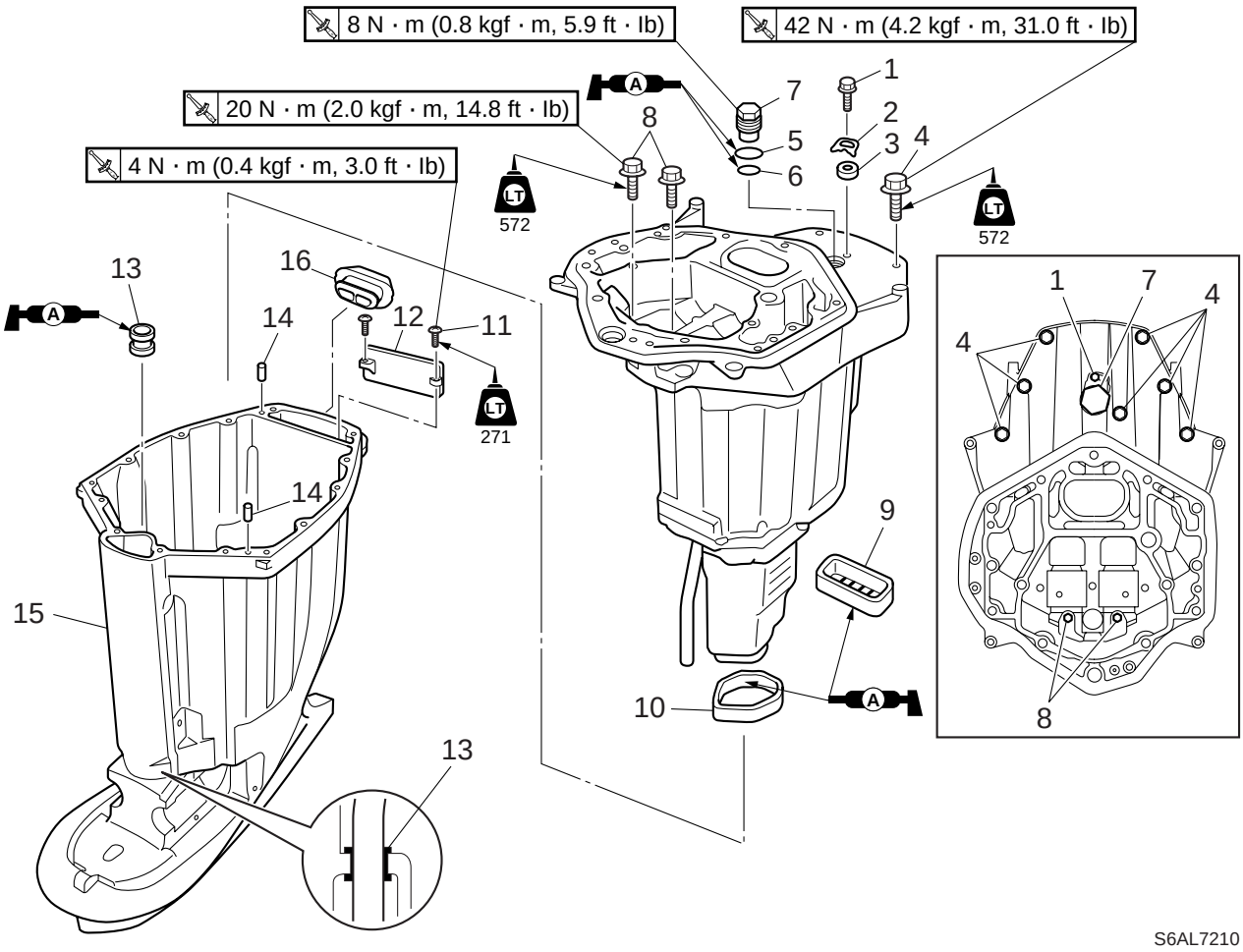


No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Bolt	2	M14 × 190 mm
3	Washer	2	
4	Washer	2	
5	Washer	2	
6	Upper mount	2	
7	Bracket	1	
8	Bolt	3	M10 × 45 mm
9	Bolt	4	M10 × 45 mm
10	Mount housing	2	
11	Bolt	2	M14 × 205 mm
12	Lower mount	2	
13	Engine oil drain bolt	1	M14 × 12 mm
14	Gasket	1	**Not reusable**
15	Bolt	2	M6 × 14 mm
16	Damper	1	
17	Apron stay	6	

7

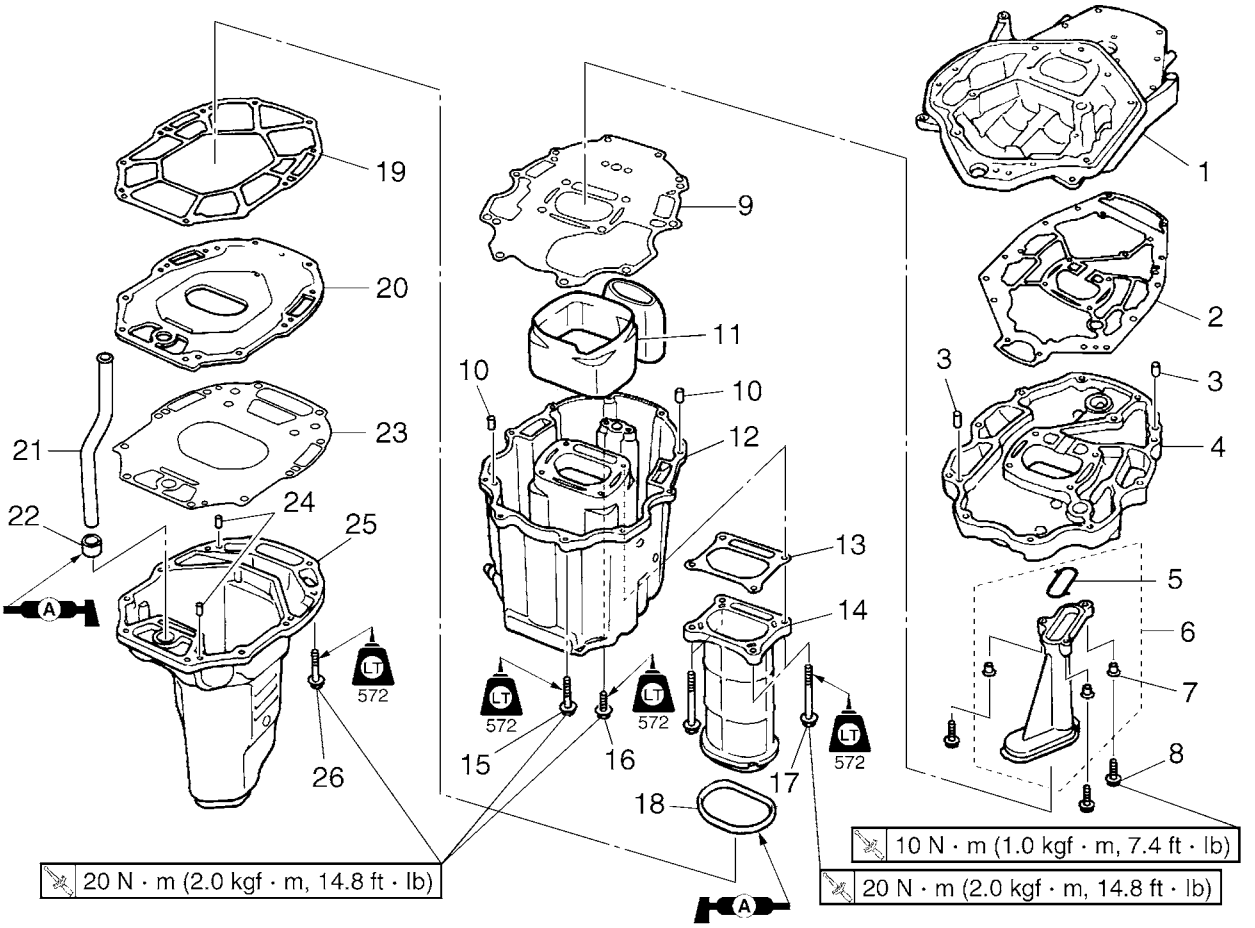


No.	Part name	Q'ty	Remarks
18	Bolt	1	M6 × 10 mm
19	Dowel	1	
20	Speedometer hose adapter	1	
21	Bolt	1	M6 × 30 mm
22	Drive shaft bushing	1	
23	Circlip	1	
24	Nut	4	
25	Circlip	1	
26	Bushing	2	
27	O-ring	1	**Not reusable**
28	Bushing	1	
29	Washer	2	
30	Steering yoke	1	
31	Washer	2	
32	Steering arm	1	
33	Washer	2	
34	Washer	2	



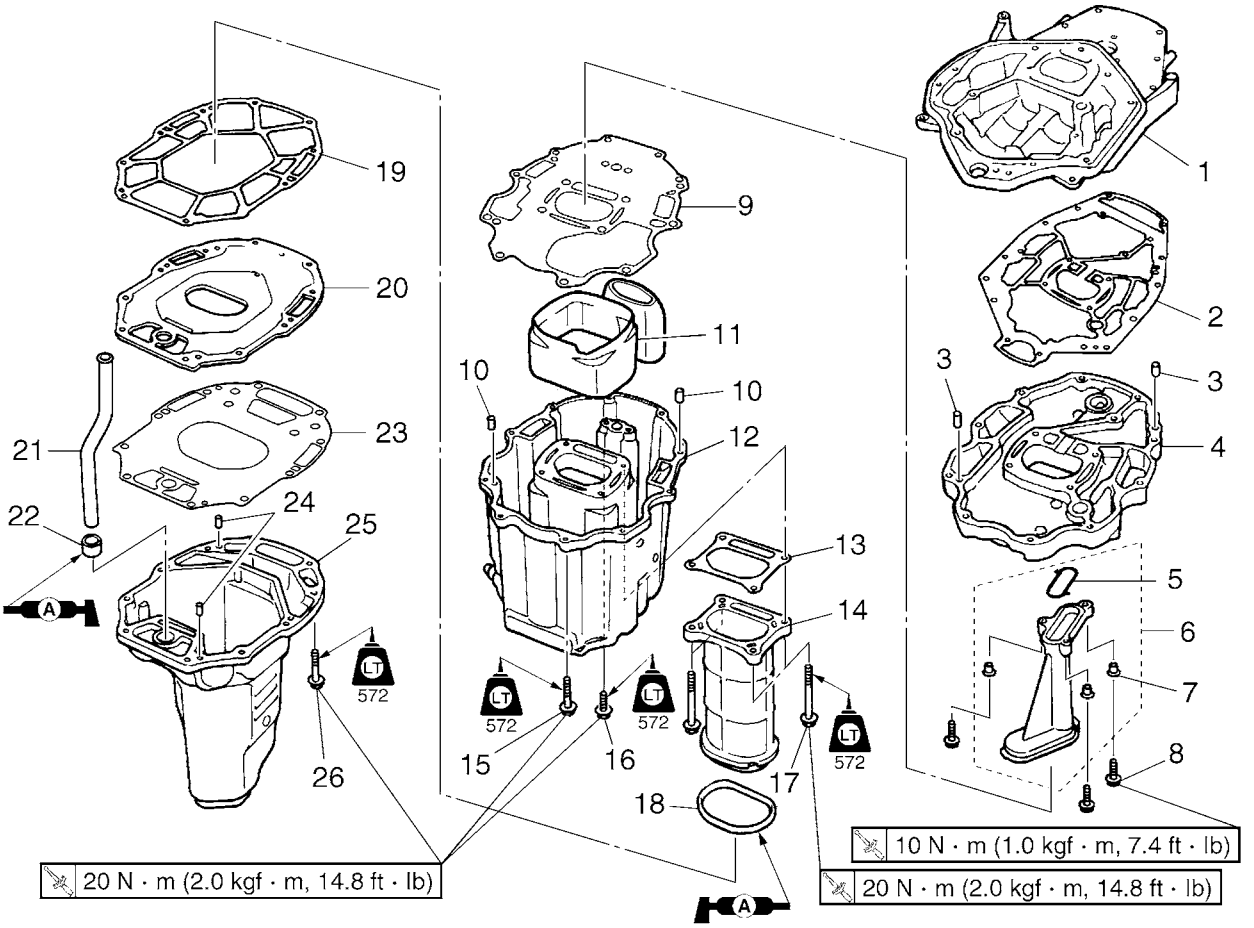
No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 20 mm
2	Plate	1	
3	Collar	1	
4	Bolt	7	M10 × 45 mm
5	O-ring	1	**Not reusable**
6	O-ring	1	**Not reusable**
7	PCV	1	
8	Bolt	2	M8 × 30 mm
9	Rubber seal	1	
10	Rubber seal	1	
11	Screw	2	ø6 × 16 mm
12	Baffle plate	1	
13	Rubber seal	1	
14	Dowel	2	
15	Upper case	1	
16	Rubber seal	1	

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No.	Part name	Q'ty	Remarks
1	Upper exhaust guide	1	
2	Gasket	1	**Not reusable**
3	Dowel	2	
4	Lower exhaust guide	1	
5	Gasket	1	**Not reusable**
6	Oil strainer	1	
7	Collar	3	
8	Bolt	3	M6 × 25 mm
9	Gasket	1	**Not reusable**
10	Dowel	2	
11	Rubber seal	1	
12	Oil pan	1	
13	Gasket	1	**Not reusable**
14	Exhaust manifold	1	
15	Bolt	10	M8 × 60 mm
16	Bolt	2	M8 × 35 mm
17	Bolt	4	M8 × 90 mm



S6AL7220

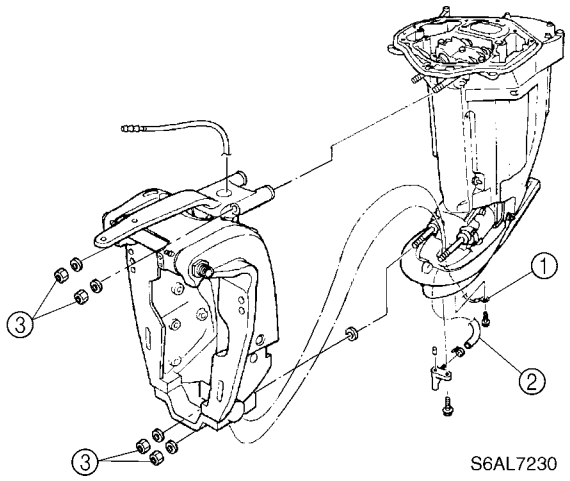
No.	Part name	Q'ty	Remarks
18	Rubber seal	1	
19	Gasket	1	**Not reusable**
20	Plate	1	
21	Pipe	1	
22	Rubber seal	1	
23	Gasket	1	**Not reusable**
24	Dowel	2	
25	Muffler	1	
26	Bolt	10	M8 × 35 mm

7

Removing the upper case

1. Disconnect the ground lead ① and speedometer hose ②.

2. Remove the upper and lower mounting nuts ③, and then remove the upper case assembly.

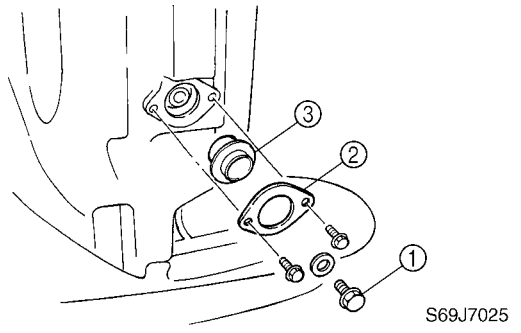


NOTE:

- It is recommended to drain the engine oil before removing the upper case.
- Be sure to remove the shift rod assembly before removing the upper case assembly from the clamp bracket.

Disassembling the upper case

1. Remove the engine oil drain bolt ①, cover ②, and damper ③.

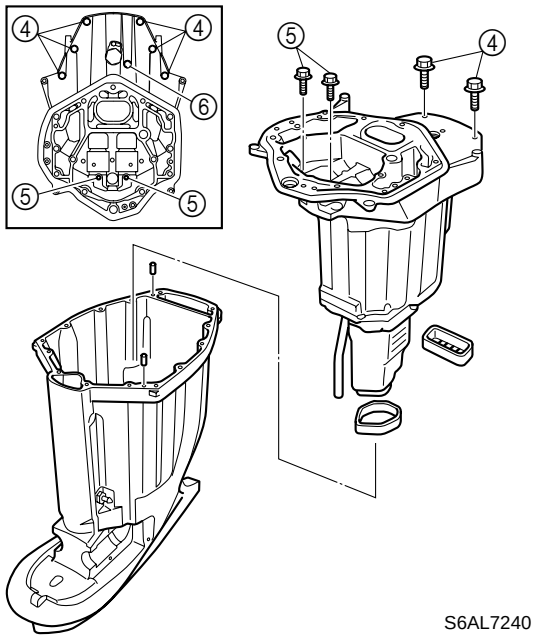


NOTE:

If the engine oil has not already been drained, place a drain pan under the drain hole before removing the engine oil drain bolt ①.

2. Remove the upper mounts and lower mounts from the upper case assembly.

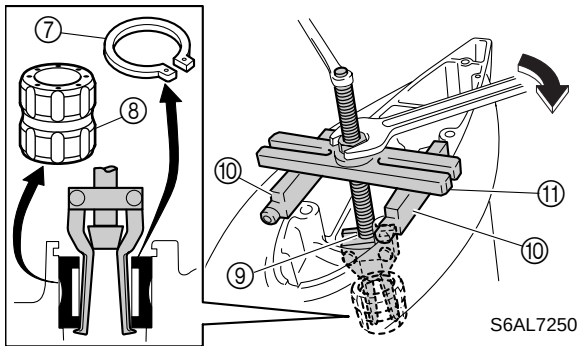
3. Remove the oil pan assembly bolts ④ and ⑤, and then remove the oil pan assembly from the upper case.



NOTE:

The bolt ⑥ is used to install the lower exhaust guide onto the upper exhaust guide. Therefore, if the oil pan assembly will be disassembled after it is removed from the upper case, also remove the bolt ⑥.

4. Remove the circlip ⑦, and then remove the drive shaft bushing ⑧.



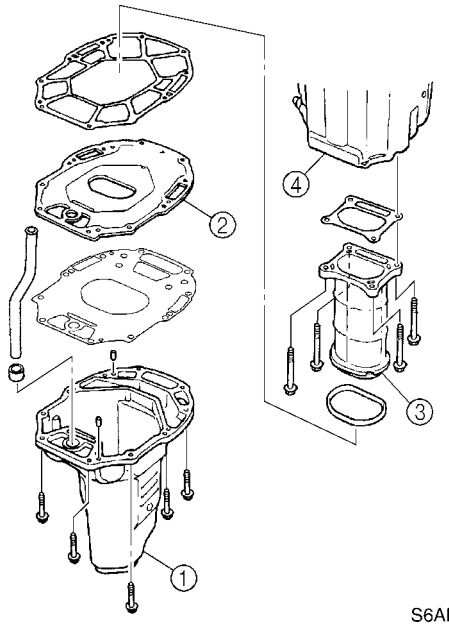
Bearing puller assembly ⑨: 90890-06535
Stopper guide stand ⑩: 90890-06538
Stopper guide plate ⑪: 90890-06501

Checking the drive shaft bushing

1. Check the drive shaft bushing. Replace if cracked or worn.

Disassembling the oil pan and exhaust manifold

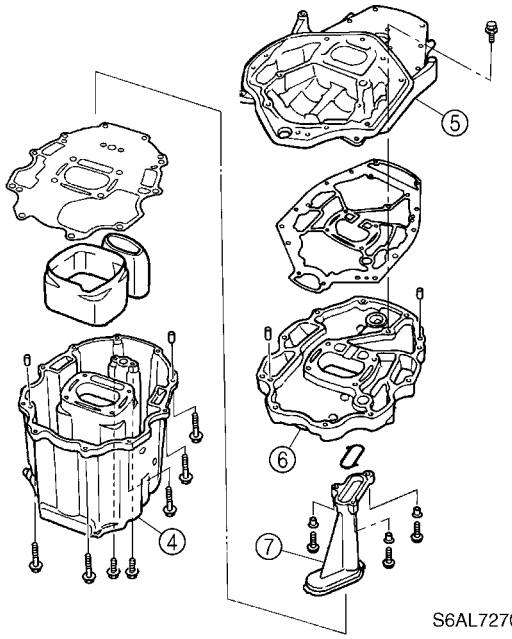
1. Remove the muffler ①, plate ②, and exhaust manifold ③ from the oil pan ④.



S6AL7260

2. Remove the oil pan ④ from the upper exhaust guide ⑤ and lower exhaust guide ⑥.

3. Remove the oil strainer ⑦ from the lower exhaust guide ⑥.



S6AL7270

Checking the oil pan and exhaust manifold

1. Clean the removed parts.

2. Check the exhaust guides, exhaust manifold, and muffler. Replace the exhaust guides, exhaust manifold, and muffler if cracked or replace if there is corrosion.

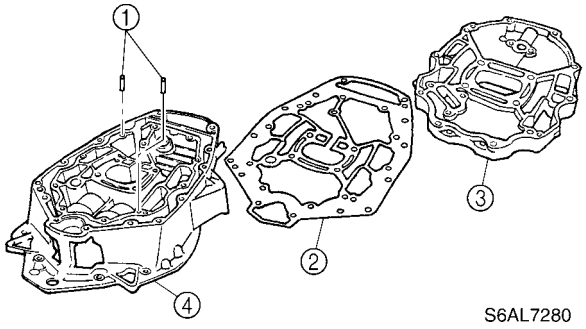
3. Check the oil pan. Replace the oil pan if cracked or replace if there is corrosion.

Checking the oil strainer

1. Check the oil strainer. Clean the oil strainer if there is dirt and residue.

Assembling the oil pan and exhaust manifold

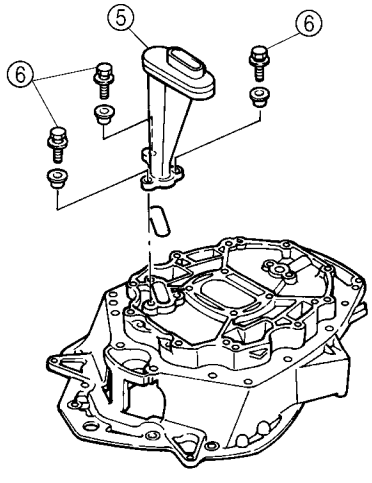
1. Install the dowels ①, a new gasket ②, and the lower exhaust guide ③ onto the upper exhaust guide ④.



S6AL7280

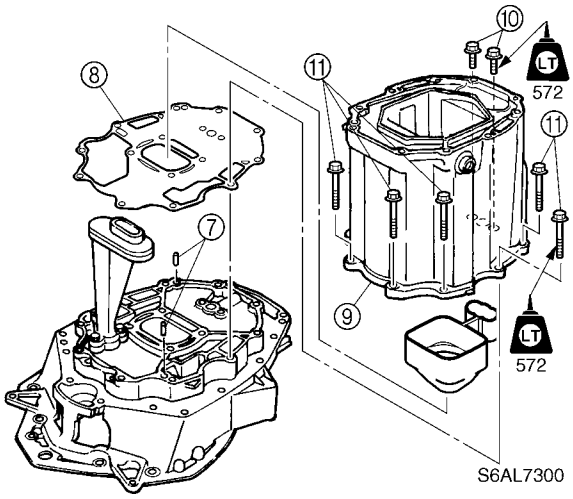
7

2. Install a new gasket, the oil strainer ⑤ and bolts ⑥, and then tighten the bolts to the specified torque.

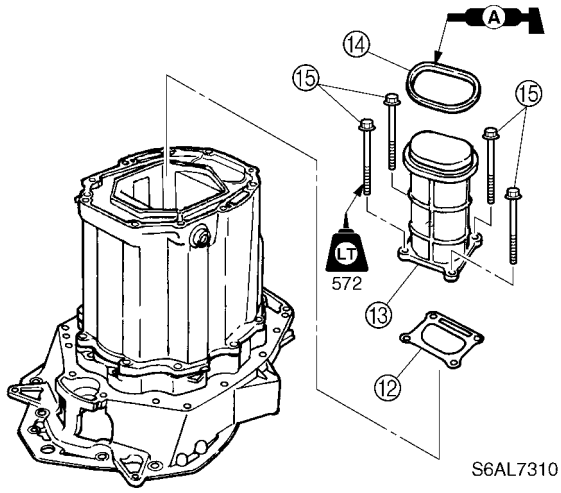


	Oil strainer bolt ⑥: 10 N·m (1.0 kgf·m, 7.4 ft·lb)

3. Install the dowels ⑦, a new gasket ⑧ and the oil pan ⑨, and then tighten the oil pan bolts ⑩ and ⑪ temporarily.



4. Install a new gasket ⑫, the exhaust manifold ⑬, rubber seal ⑭, and then tighten the exhaust manifold bolts ⑮ temporarily.



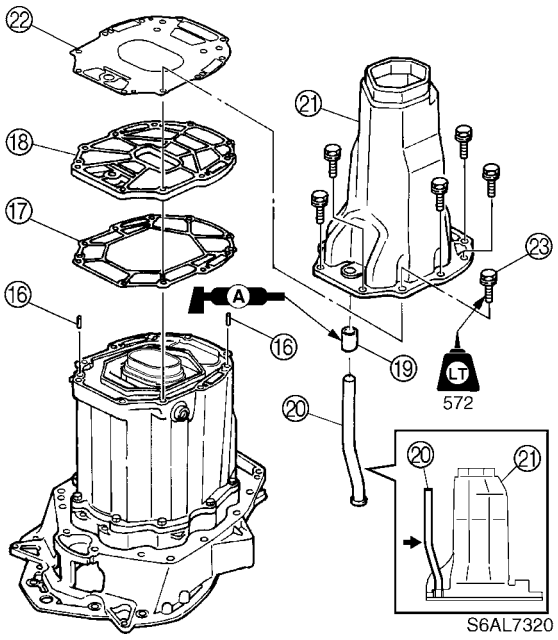
5. Tighten the exhaust manifold bolts ⑮ first, and then tighten the oil pan bolts ⑩ and ⑪ to the specified torques.

	Exhaust manifold bolt ⑮: 20 N·m (2.0 kgf·m, 14.8 ft·lb) Oil pan bolt ⑩, ⑪: 20 N·m (2.0 kgf·m, 14.8 ft·lb)

6. Install the dowels ⑯, a new gasket ⑰, and the plate ⑱.

7. Install the rubber seal ⑲ and cooling water pipe ⑳ into the muffler ㉑.

8. Install a new gasket ㉒, the muffler ㉑ and bolts ㉓ onto the oil pan, and then tighten the bolts ㉓ to the specified torque.

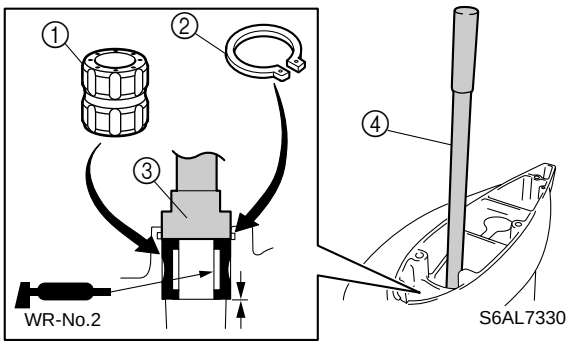


NOTE:
Install the cooling water pipe positioned as shown.

Muffler bolt ㉓:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

Assembling the upper case

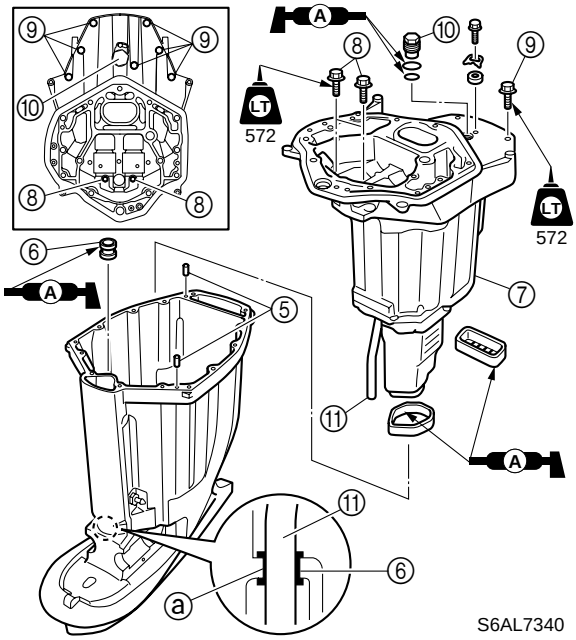
1. Install the drive shaft bushing ① into the upper case, and then install the circlip ②.



NOTE:
After installing the drive shaft bushing, apply grease to the inside of the bushing.

Needle bearing attachment ③:
90890-06653
Driver rod L3 ④: 90890-06652

2. Install the dowels ⑤ onto the upper case.
3. Install the rubber seal ⑥ into the joint hole ⓐ of the upper case.
4. Install the oil pan assembly ⑦.
5. Install the oil pan assembly bolts ⑧ and ⑨ and PCV ⑩, and then tighten them to the specified torques.

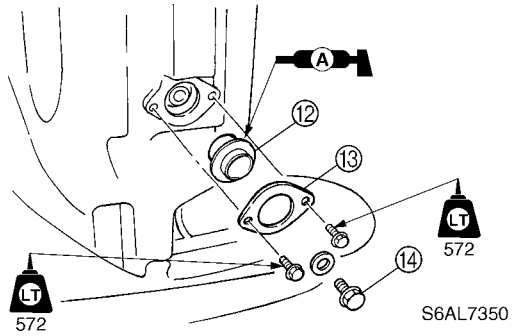


NOTE:
Be sure to insert the tip of the cooling water pipe ⑪ into the joint hole ⓐ of the upper case.

Oil pan assembly bolt (M8) ⑧:
20 N·m (2.0 kgf·m, 14.8 ft·lb)
Oil pan assembly bolt (M10) ⑨:
42 N·m (4.2 kgf·m, 31.0 ft·lb)
PCV ⑩: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

7

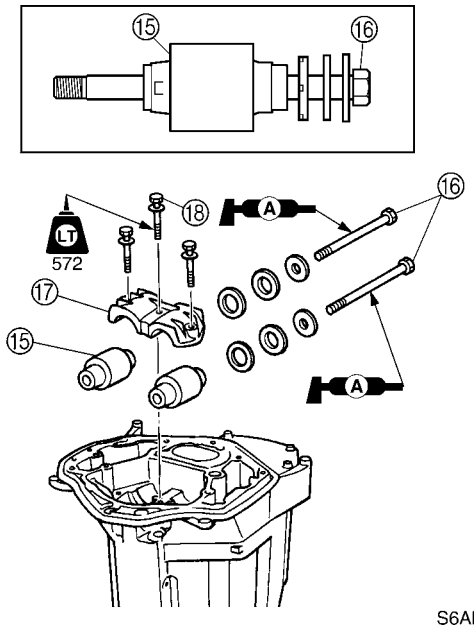
6. Install the damper ⑫, cover ⑬, and engine oil drain bolt ⑭, and then tighten the drain bolt to the specified torque.



Engine oil drain bolt ⑭:
27 N·m (2.7 kgf·m, 19.9 ft·lb)

7. Install the upper mounts ⑮ and upper mount bolts ⑯ into the upper case.

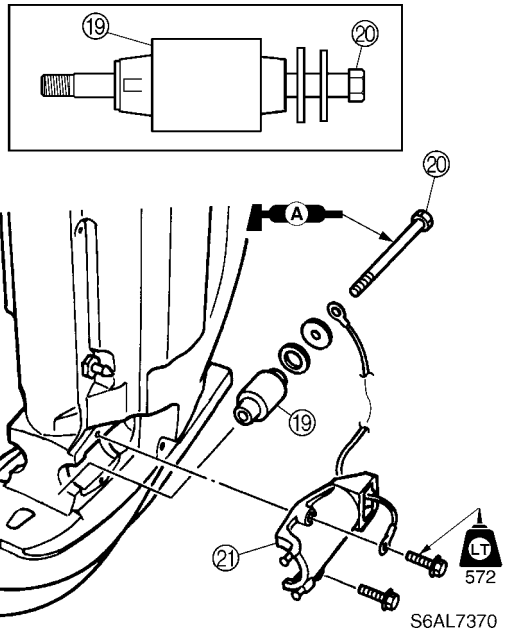
8. Install the bracket ⑰, and then tighten the upper mount bracket bolts ⑱ to the specified torque.



NOTE:
First tighten the center located, when tighten the upper mount bracket bolts ⑱.

Upper mount bracket bolt ⑱:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

9. Install the lower mounts ⑲, lower mount bolts ⑳, and mount housings ㉑.



NOTE:
Make sure that the ground lead is not damaged.

Installing the upper case

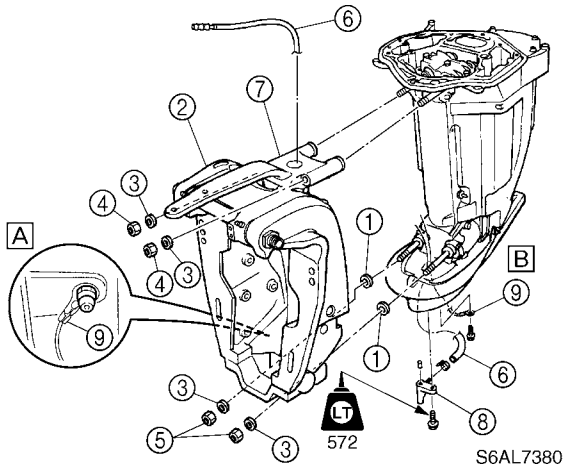
1. Install the washers ① onto the lower mounting bolts.

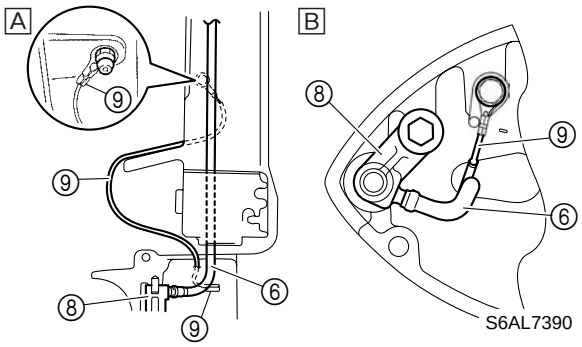
2. Install the upper and lower mounting bolts into the bracket assembly ② simultaneously.

3. Install the washers ③, upper mounting nuts ④, and lower mounting nuts ⑤, and then tighten them to the specified torques.

4. Pass the speedometer hose ⑥ through the steering arm ⑦, and then connect it to the speedometer hose adapter ⑧.

5. Connect the ground lead ⑨.

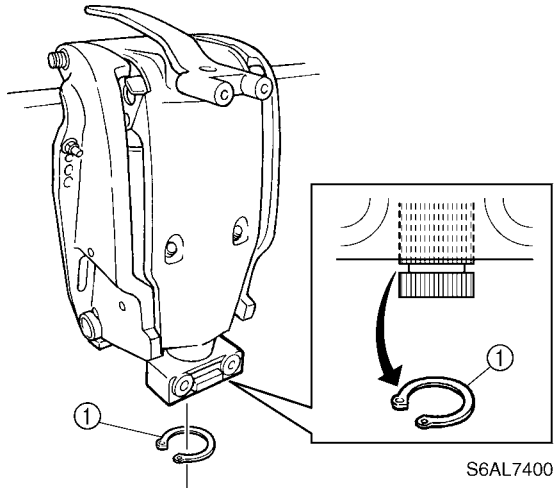




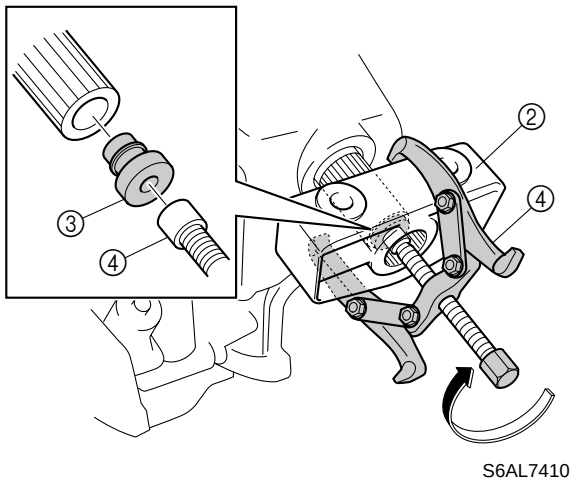
Upper mounting nut ④:
72 N·m (7.2 kgf·m, 53.1 ft·lb)
Lower mounting nut ⑤:
72 N·m (7.2 kgf·m, 53.1 ft·lb)

Removing the steering arm

1. Remove the circlip ①.



2. Remove the steering yoke ② as shown.



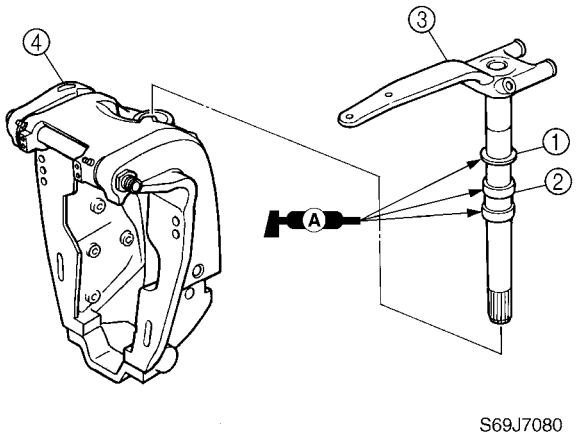
Needle bearing attachment ③:
90890-06612
Gear puller ④:
(commercially available)

3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

Installing the steering arm

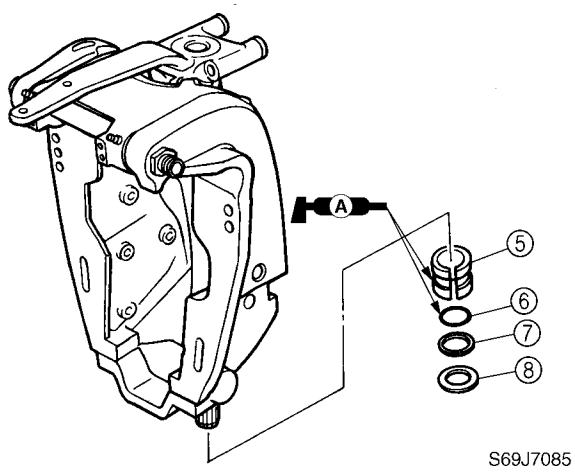
1. Install the washer ① and bushing ② onto the steering arm ③.

2. Place the swivel bracket ④ in an upright position, and then install the steering arm onto the swivel bracket.



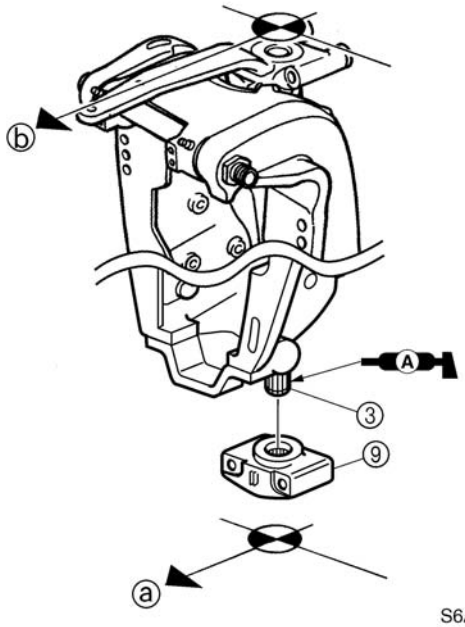
7

3. Install the bushing ⑤, a new O-ring ⑥, the bushing ⑦, and the washer ⑧ onto the swivel bracket.



S69J7085

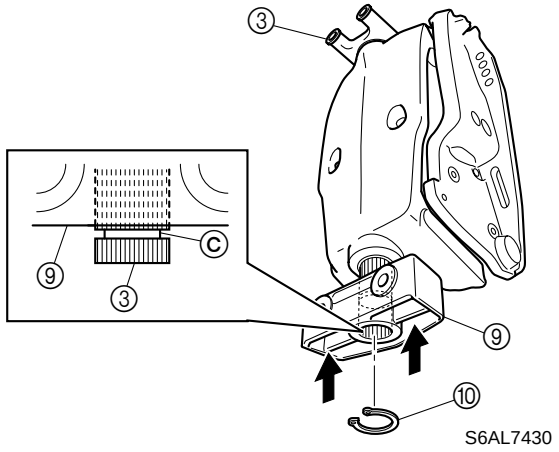
4. Install the steering yoke ⑨ onto the steering arm ③, making sure that they are both facing in the same direction (ⓐ and ⓑ are aligned).



S6AL7420

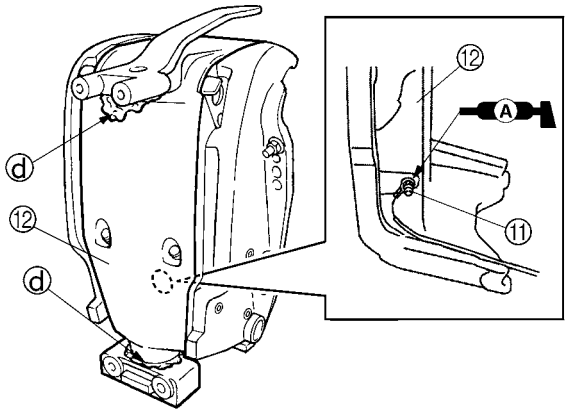
5. Hold the steering arm ③, and then strike the steering yoke ⑨ until the slot ⓒ for installing the circlip is visible.

6. Install the circlip ⑩.



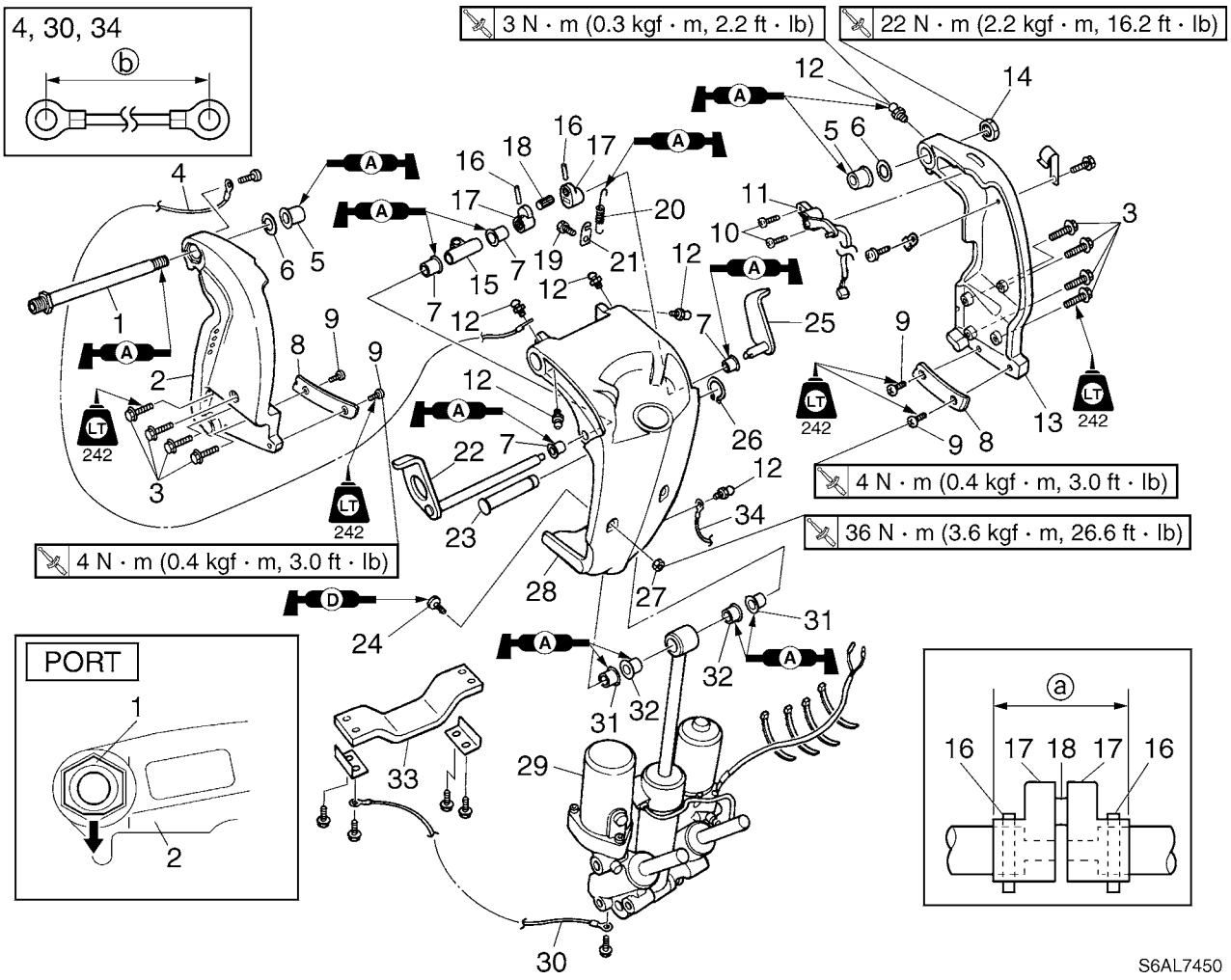
S6AL7430

7. Inject grease into the grease nipple ⑪ on the swivel bracket ⑫ until grease comes out from both the upper and lower bushings ⓓ.



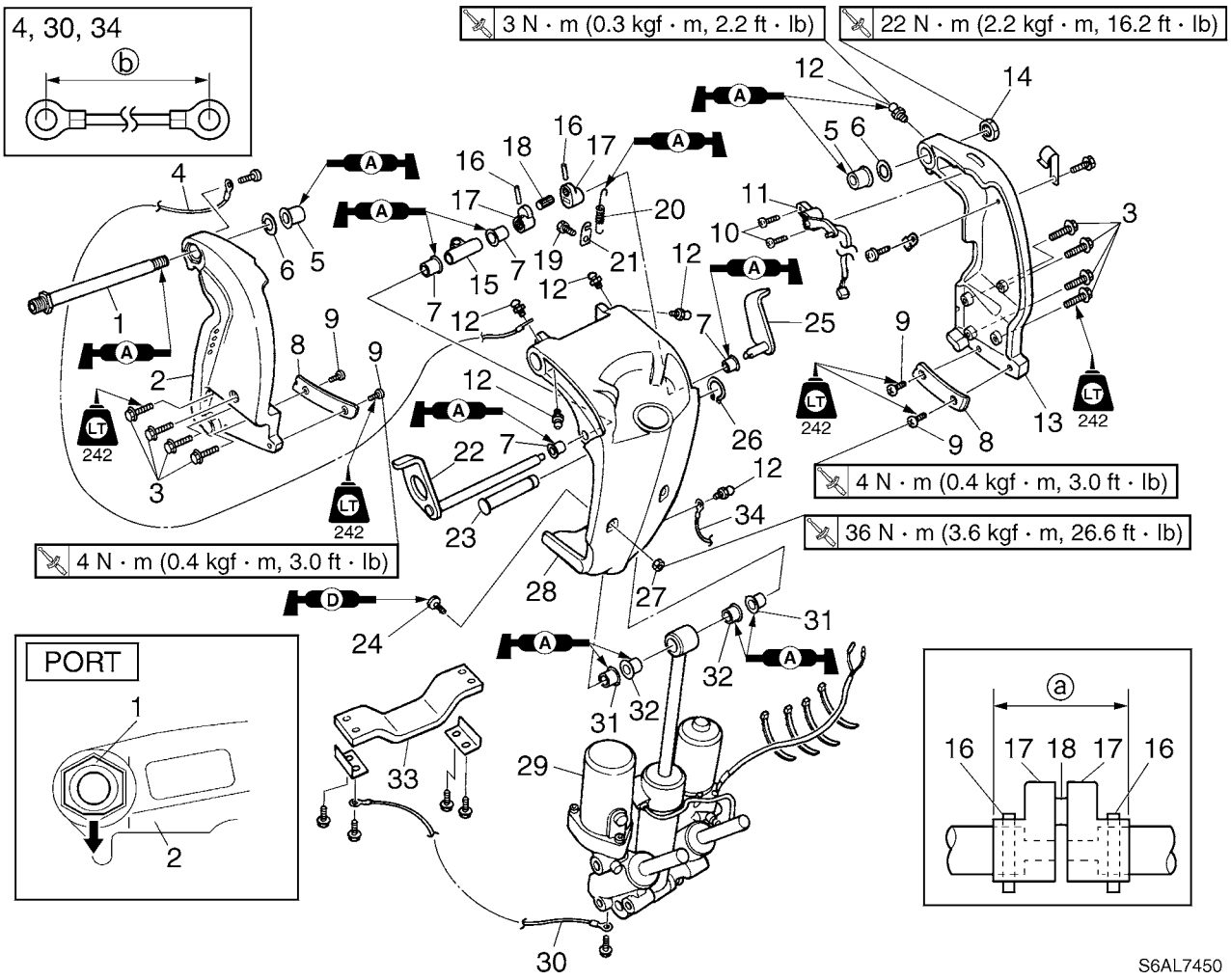
S6AL7440

Clamp bracket and swivel bracket



No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Clamp bracket (PORT)	1	
3	Bolt	8	M10 × 45 mm
4	Ground lead	1	ⓑ: 120 mm (4.7 in)
5	Bushing	2	
6	Washer	2	
7	Bushing	4	
8	Friction plate	2	
9	Screw	4	ø6 × 10 mm
10	Screw	2	ø6 × 15 mm
11	Trim sensor	1	
12	Grease nipple	6	
13	Clamp bracket (STBD)	1	
14	Self-locking nut	1	
15	Collar	1	
16	Pin	2	
17	Distance collar	2	ⓐ: 30.3–30.4 mm (1.19–1.20 in)

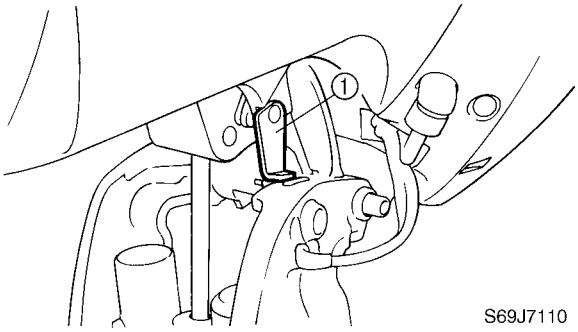
7



No.	Part name	Q'ty	Remarks
18	Pin	1	
19	Bolt	1	M6 × 10 mm
20	Spring	1	
21	Spring holder	1	
22	Tilt stop lever (PORT)	1	
23	Shaft	1	
24	Trim stopper	2	
25	Tilt stop lever (STBD)	1	
26	Circlip	1	
27	Nut	2	
28	Swivel bracket	1	
29	PTT unit	1	
30	Ground lead	1	ⓑ: 180 mm (7.1 in)
31	Bushing	2	
32	Bushing	2	
33	Anode	1	
34	Ground lead	1	ⓑ: 350 mm (13.8 in)

Removing the PTT unit

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



⚠ WARNING

- **After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.**
- **When removing the PTT unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**

NOTE:

If the PTT does not operate, open the manual valve by turning it counter clockwise, and then tilt the outboard motor up manually.

2. Remove the holder ②, plastic ties ③, and PTT motor lead ④ from the holder ⑤, and then pull out the PTT motor lead.

3. Loosen the self-locking nut ⑥ of the through tube.

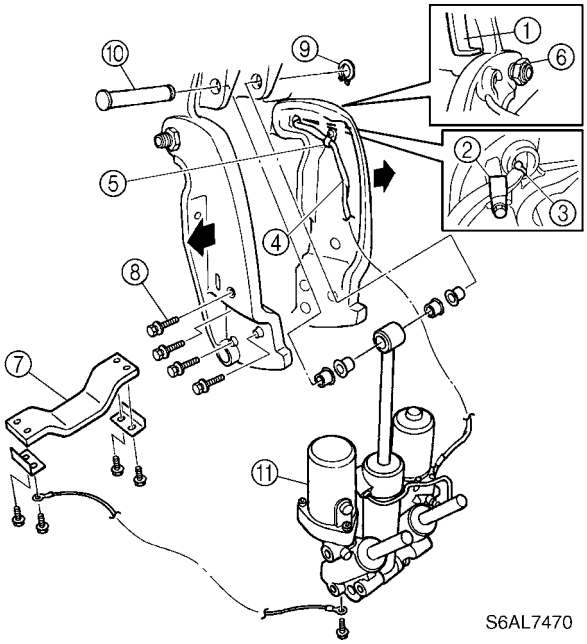
4. Remove the anode ⑦ and the PTT unit bolts ⑧ (8 bolts), and then move the clamp brackets slightly in the direction of the arrows.

⚠ WARNING

Do not remove the tilt stop lever ① from the clamp brackets.

5. Remove the circlip ⑨ and shaft ⑩, then the upper end of the tilt rod from the swivel bracket.

6. Remove the PTT unit ⑪.

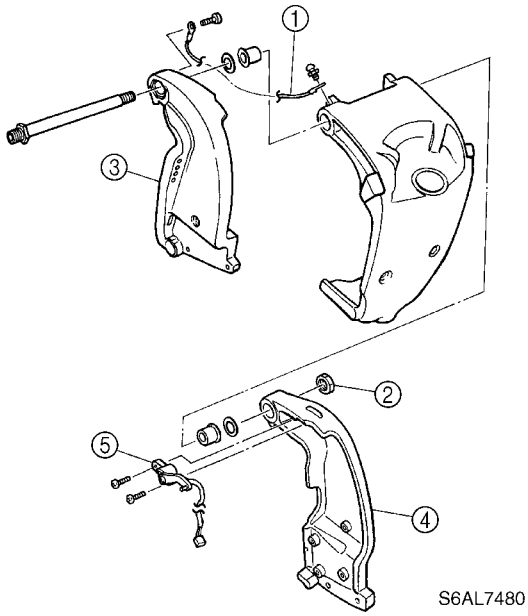


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Removing the clamp bracket

1. Remove the ground lead ① and self-locking nut ② of the through tube, then clamp brackets ③ and ④.

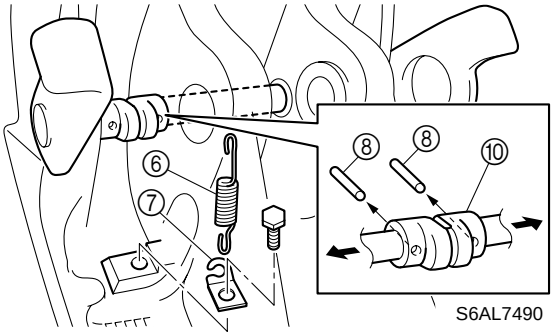
2. Remove the trim sensor ⑤.



S6AL7480

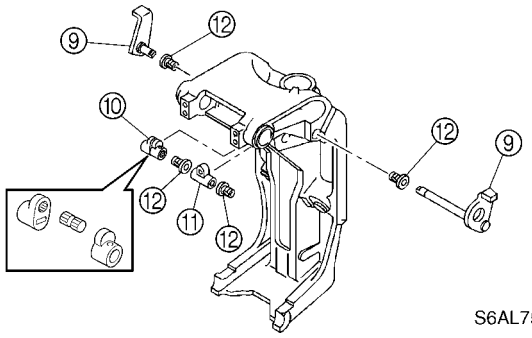
NOTE:
Be sure to remove the ground lead ① before removing the self-locking nut ②.

3. Remove the spring ⑥, holder ⑦, and pins ⑧.



S6AL7490

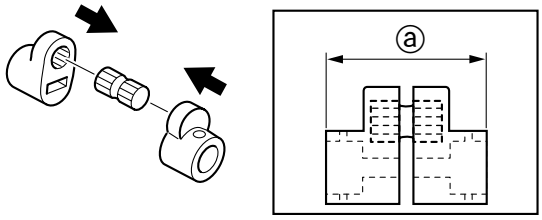
4. Remove the tilt stop levers ⑨, distance collar ⑩, collar ⑪, and bushings ⑫.



S6AL7500

Installing the clamp bracket

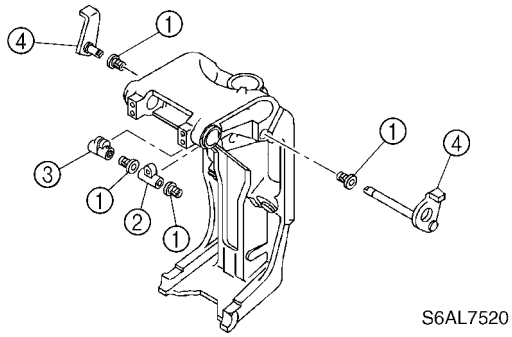
1. Assemble the distance collar.



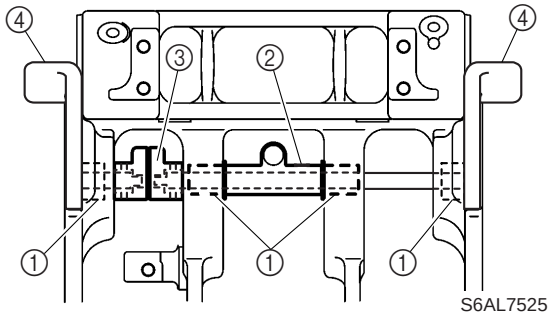
S6AL7510

NOTE:
Make sure that the distance ⓐ shown is 30.3–30.4 mm (1.19–1.20 in).

2. Install the bushings ①, collar ②, distance collar ③, and tilt stop levers ④.



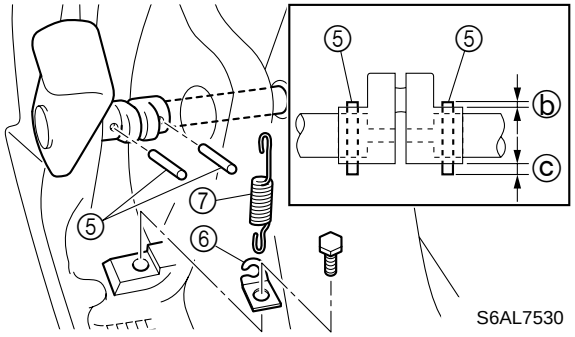
S6AL7520



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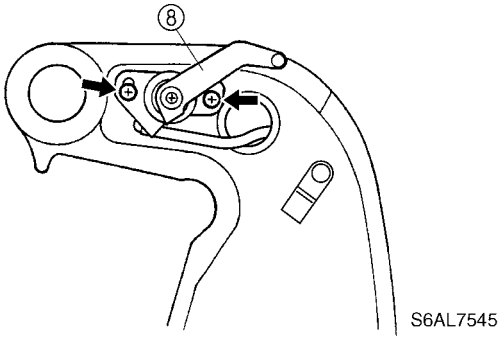
NOTE:
Be sure to install the distance collars ③ and tilt stop levers ④ so that they are facing in the directions shown.

3. Install the pins ⑤, holder ⑥, and spring ⑦.



NOTE:
Make sure that the end ⓒ of each pin ⑤ is longer than the end ⓑ.

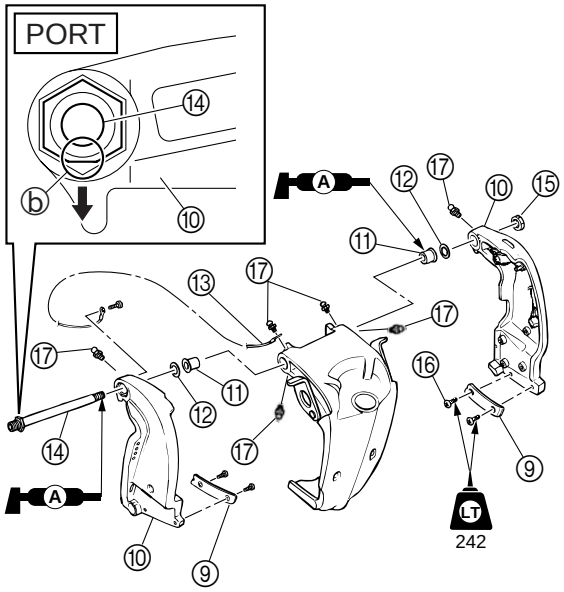
4. Install the trim sensor ⑧ onto the starboard clamp bracket.



NOTE:
- It is possible to install and remove the trim sensor ⑧ even after the clamp bracket assembly is installed.
- Adjust the trim sensor after installing the PTT unit. To adjust the trim sensor, see Chapter 7, “Adjusting the trim sensor.”

5. Install the friction plates ⑨ onto the clamp brackets ⑩, then install the bushings ⑪, washers ⑫, and then assemble the clamp brackets and the swivel bracket.

6. Connect the ground lead ⑬, install the through tube ⑭, and then tighten the self-locking nut ⑮ temporarily.



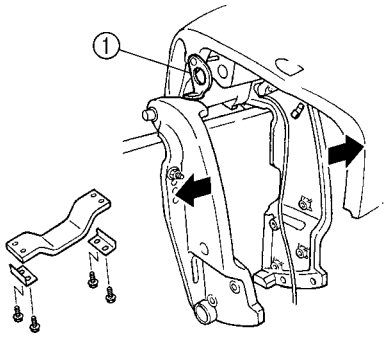
NOTE:
- Do not pinch the trim sensor pin when down the swivel bracket.
- Be sure to install the through tube ⑭ with its flat corner ⓑ pointing down as shown.

	Friction plate screw ⑯: 4 N·m (0.4 kgf·m, 3.0 ft·lb) Grease nipple ⑰: 3 N·m (0.3 kgf·m, 2.2 ft·lb)

7

Installing the PTT unit

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



⚠ WARNING

- **When installing the PTT unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**
- **After tilting the outboard motor up, be sure to support it with the tilt stop lever.**

2. Install the PTT unit mounting bolts ② onto both clamp brackets together with the PTT unit ③, and then tighten them.

3. Install the upper end of the tilt ram into the swivel bracket with the shaft ④ and circlip ⑤.

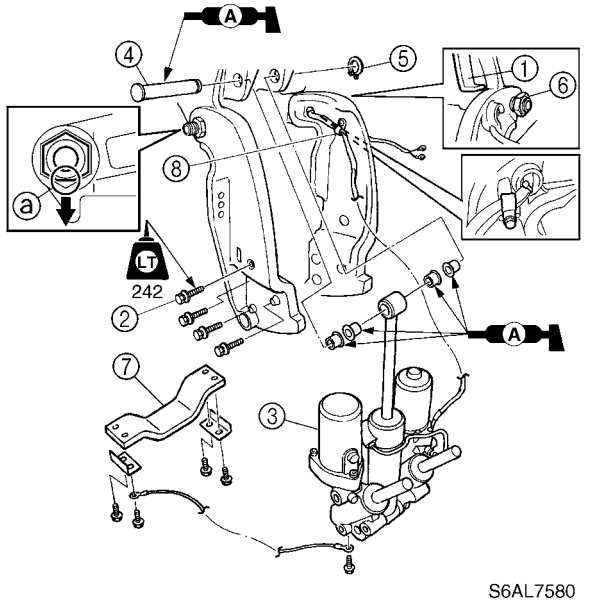
4. Tighten the self-locking nut ⑥ of the through tube to the specified torque.

NOTE:

- Make sure that the flat corner ⓐ of the through tube is pointing down as shown before tightening the self-locking nut ⑥.
- Do not pinch the trim sensor pin when down the swivel bracket.

5. Install the anode ⑦ and ground lead.

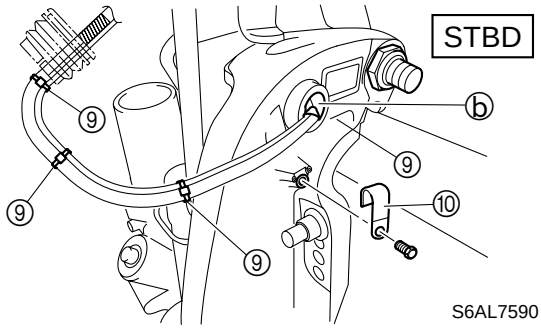
6. Install the PTT motor lead to the holder ⑧.



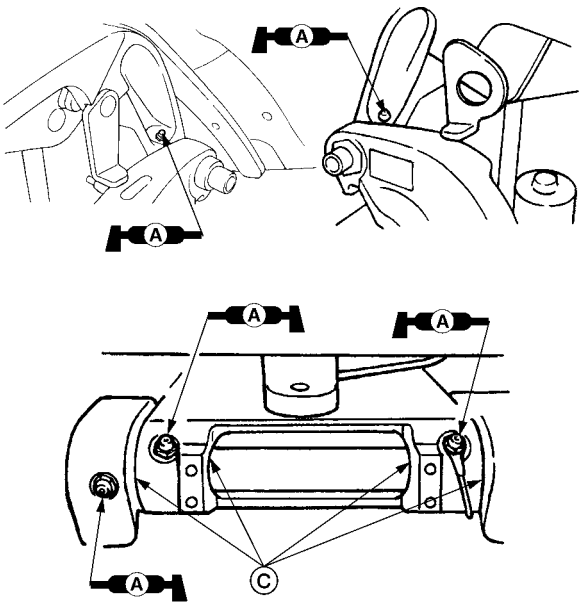
	Self-locking nut ⑥: 22 N·m (2.2 kgf·m, 16.2 ft·lb)

7. Pass the PTT motor lead and trim sensor lead through the hole ⓑ in the starboard clamp bracket.

8. Fasten the PTT motor lead and trim sensor lead with the plastic ties ⑨, and then install the holder ⑩.



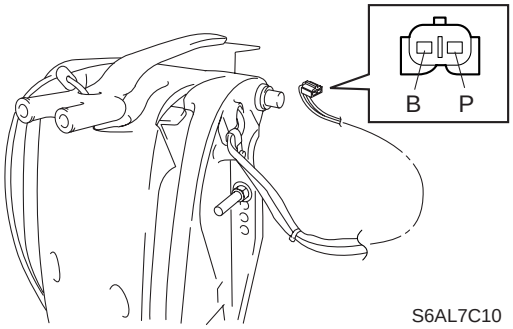
9. Inject grease into all grease nipples until grease comes out from the bushings ⓒ.



S6AL7600

Adjusting the trim sensor

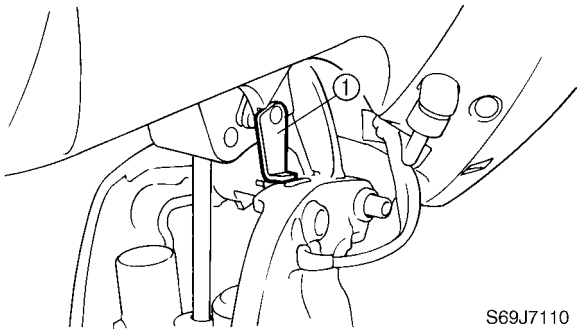
1. Fully tilt the outboard motor down.
2. Measure the trim sensor resistance, and note the measurement data.



S6AL7C10

Trim sensor setting resistance:
Pink (P) – Black (B)
10 ± 1 Ω

3. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.

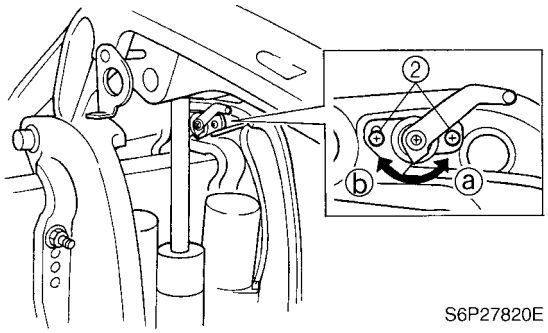


S69J7110

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.

4. Loosen the trim sensor screws ②.
5. Adjust the position of the trim sensor, and then tighten the trim sensor screws ② temporarily.



S6P27820E

NOTE:

- To decrease the resistance, turn the trim sensor in direction ⓐ.
- To increase the resistance, turn the trim sensor in direction ⓑ.

6. Fully tilt the outboard motor down.
7. Measure the trim sensor resistance. Repeat steps 3–6 if out of specification.

Trim sensor setting resistance:
Pink (P) – Black (B)
10 ± 1 Ω

7

8. Fully tilt the outboard motor up, and then support it with the tilt stop lever.

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.

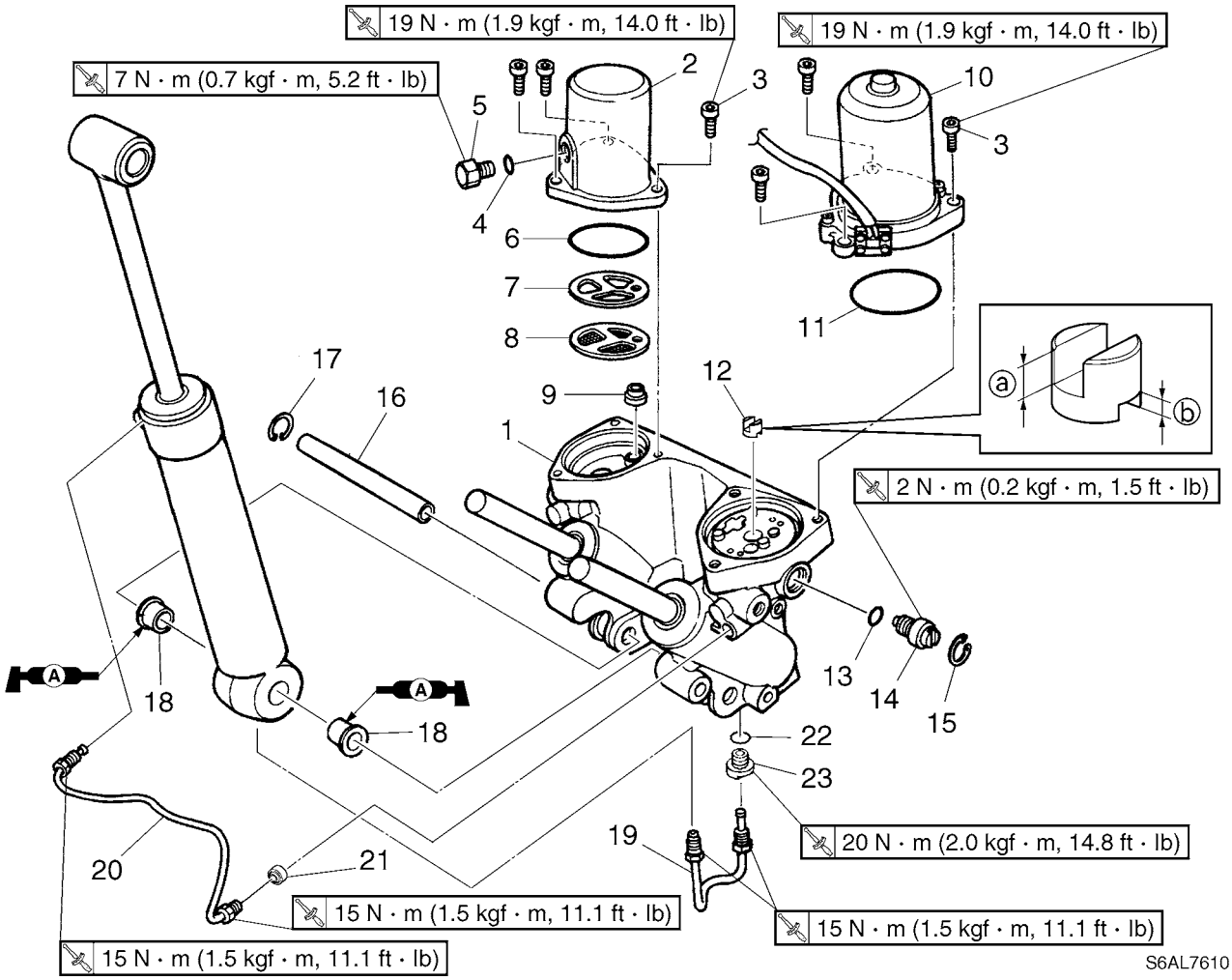
9. Tighten the trim sensor screws ②.

10. Fully tilt the outboard motor down.

NOTE:

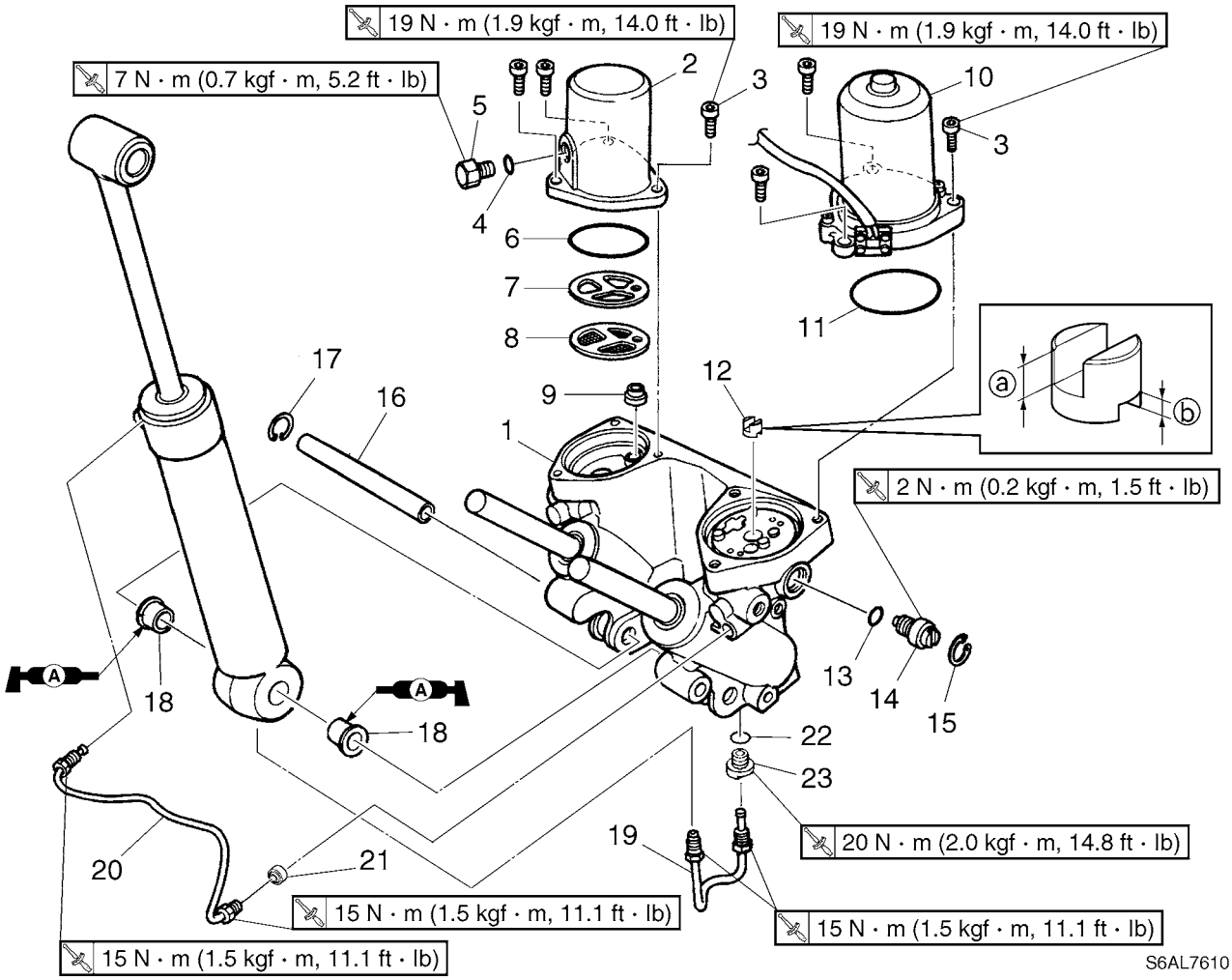
- Check the trim sensor resistance again after tightening the trim sensor screws ② and fully tilting the outboard motor down.
- To check the trim sensor, see Chapter 7, “Checking the trim sensor.”

PTT unit



No.	Part name	Q'ty	Remarks
1	PTT body	1	
2	Reservoir	1	
3	Bolt	6	M8 × 20 mm
4	O-ring	1	**Not reusable**
5	Reservoir cap	1	M12 × 10 mm
6	O-ring	1	**Not reusable**
7	Sheet	1	
8	Filter	1	
9	Spacer	1	
10	PTT motor assembly	1	
11	O-ring	1	**Not reusable**
12	Joint	1	The height ⓐ is greater than the height ⓑ.
13	O-ring	1	**Not reusable**
14	Manual valve	1	
15	Circlip	1	
16	Shaft	1	
17	Circlip	1	

7



No.	Part name	Q'ty	Remarks
18	Bushing	2	
19	Pipe	1	
20	Pipe	1	
21	Spacer	1	
22	O-ring	1	**Not reusable**
23	Adapter	1	

Checking the hydraulic pressure

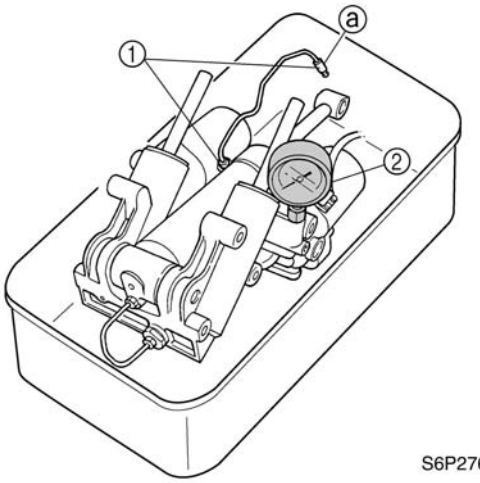
NOTE:
Check the hydraulic pressure. Using the special service tool check the internal parts if out of specification.

1. Fully extend the trim and tilt rams.
2. Loosen the pipe joints ①, and then remove the pipe joint at the end ⓐ.

⚠ WARNING

Make sure that the trim and tilt rams are fully extended when removing the pipe joints ①, otherwise fluid can spurt out from the unit due to internal pressure.

3. Install the special service tool ②.

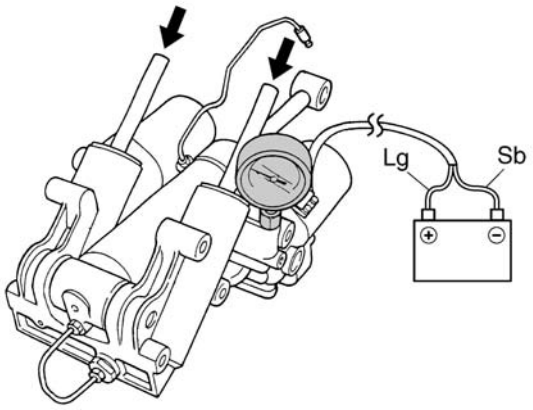


S6P27610

NOTE:
Put the PTT unit in the drain pan.

PTT oil pressure gauge assembly ②:
90890-06580

4. Connect the PTT motor leads to the battery terminals to retract the trim rams, and then measure the maximum hydraulic pressure when the reading on the PTT oil pressure gauge stabilizes.

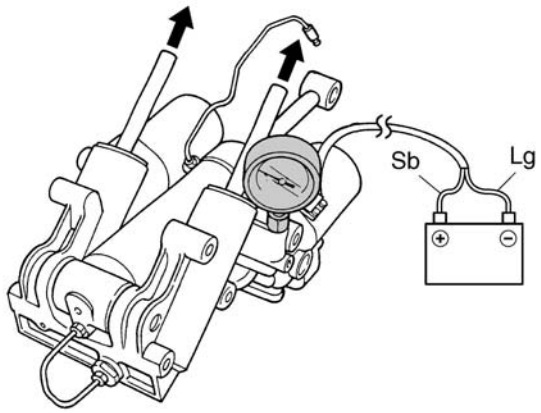


S6AL7C04

Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

Hydraulic pressure (down):
6.7–8.7 MPa (67–87 kgf/cm^2)

5. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



S6AL7C05

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

7

6. Remove the special service tool ②.

⚠ WARNING

Make sure that the trim and tilt rams are fully extended when removing the special service tool ②, otherwise fluid can spurt out from the unit due to internal pressure.

7. Install the pipe joint at the end ⓐ, and then tighten the pipe joints ① to the specified torque.

Pipe joint ①:
15 N·m (1.5 kgf·m, 11.1 ft·lb)

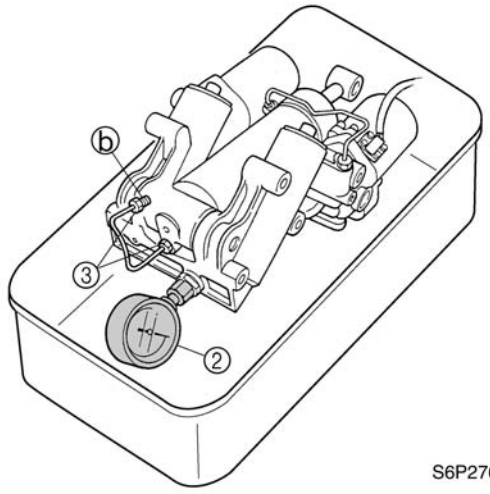
8. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.

9. Loosen the pipe joints ③, and then remove the pipe joint at the end ⓑ.

⚠ WARNING

Make sure that the trim and tilt rams are fully retracted when removing the pipe joints ③, otherwise fluid can spurt out from the unit due to internal pressure.

10. Install the special service tool ②.

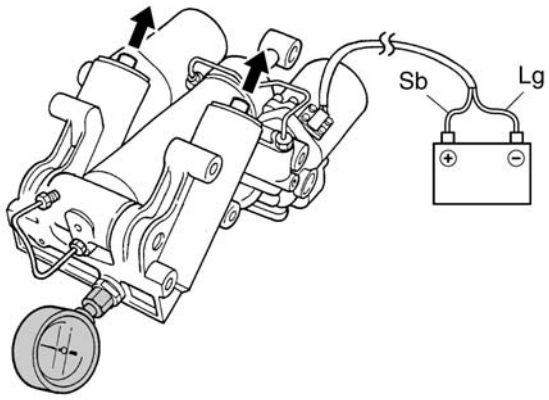


S6P27640

NOTE:
Put the PTT unit in the drain pan.

PTT oil pressure gauge assembly ②:
90890-06580

11. Connect the PTT motor leads to the battery terminals to extend the trim rams, and then measure the hydraulic pressure.

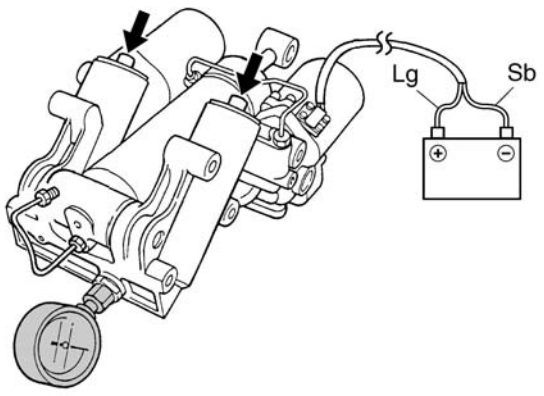


S6AL7C06

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

Hydraulic pressure (up):
13.0–15.0 MPa (130–150 kgf/cm^2)

12. Reverse the PTT motor leads between the battery terminals to fully retract the trim and tilt rams.



S6AL7C07

Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

13. Remove the special service tool ②.

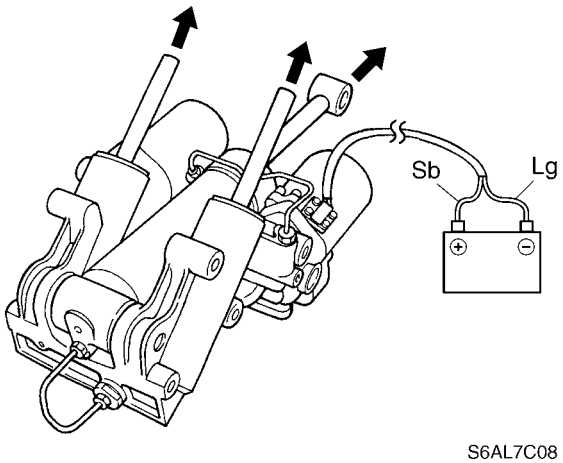
⚠ WARNING

Make sure that the trim and tilt rams are fully retracted when removing the special service tool ②, otherwise fluid can spurt out from the unit due to internal pressure.

14. Install the pipe joint at the end ⓑ, and then tighten the pipe joints ③ to the specified torque.

	Pipe joint ③: 15 N·m (1.5 kgf·m, 11.1 ft·lb)

15. After measuring the hydraulic pressure, connect the PTT motor leads to the battery terminals to fully extend the trim and tilt rams.



S6AL7C08

16. Place the PTT unit in an upright position.

17. Remove the reservoir cap ④, and then check the fluid level in the reservoir.

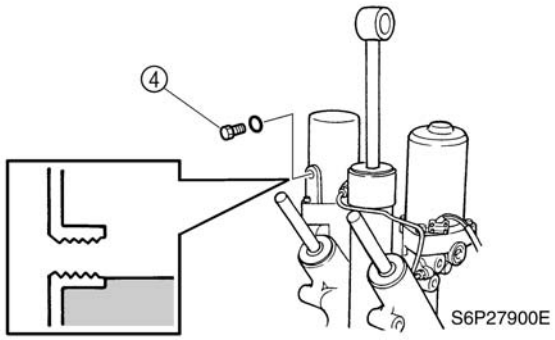
⚠ WARNING

Make sure that the trim and tilt rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.

NOTE:

If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole when the cap is removed.

18. If necessary, add sufficient fluid of the recommended type to the correct level.



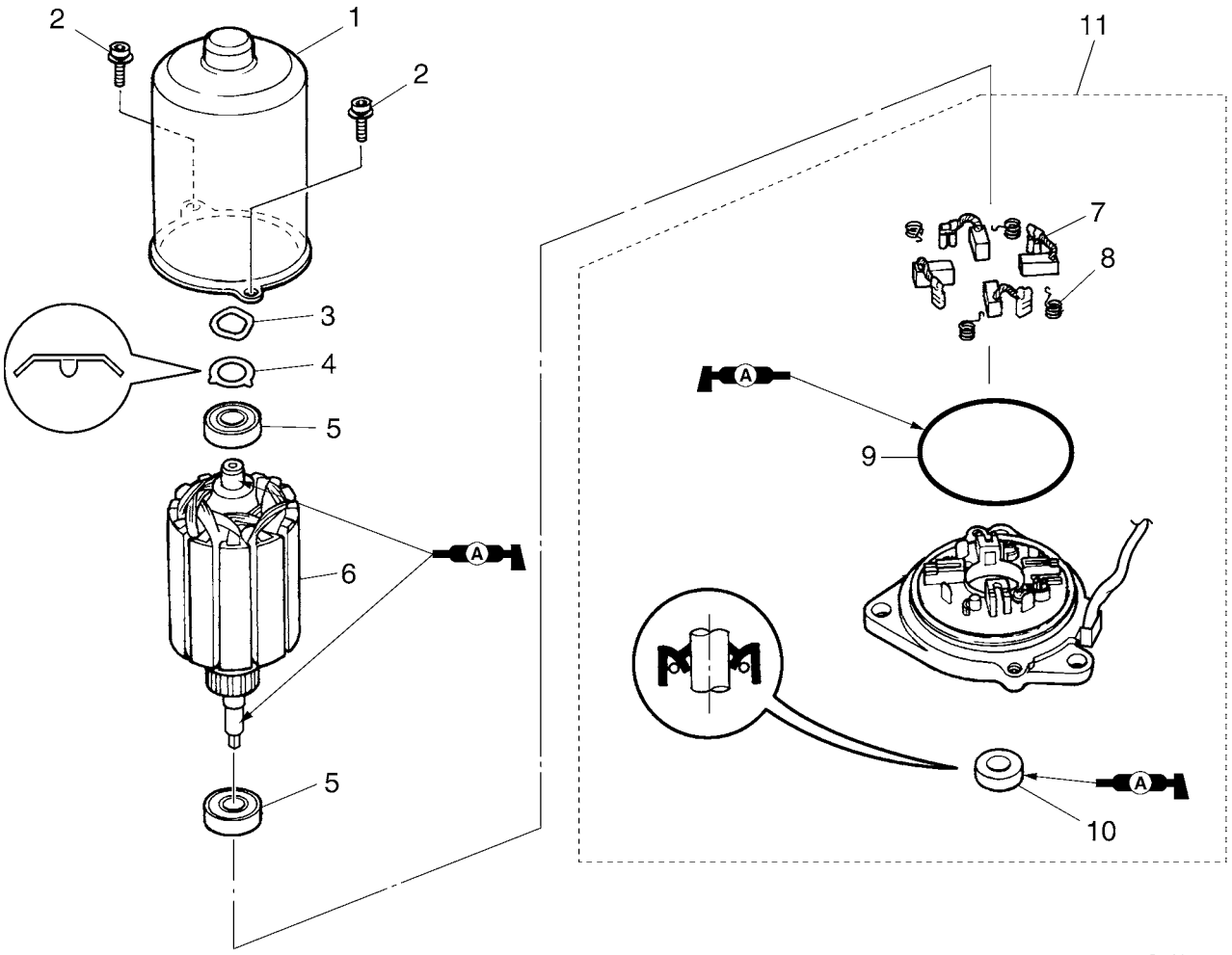
S6P27900E

19. Install the reservoir cap ④, and then tighten it to the specified torque.

	Reservoir cap ④: 7 N·m (0.7 kgf·m, 5.2 ft·lb)

7

PTT motor



S6AL7620

No.	Part name	Q'ty	Remarks
1	Stator	1	
2	Bolt	2	M5 × 12 mm
3	Wave washer	1	
4	Washer	1	
5	Bearing	2	
6	Armature	1	
7	Brush	4	
8	Spring	4	
9	O-ring	1	**Not reusable**
10	Oil seal	1	**Not reusable**
11	PTT motor base assembly	1	

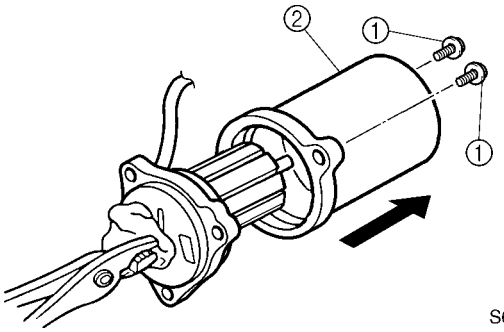
Disassembling the PTT motor

1. Remove the PTT motor assembly, O-ring, and joint from the PTT unit.

⚠ WARNING

Do not push the trim and tilt rams down while the PTT motor is removed from the PTT unit, otherwise fluid can spurt out.

2. Remove the PTT motor screws ①, then the stator ②.

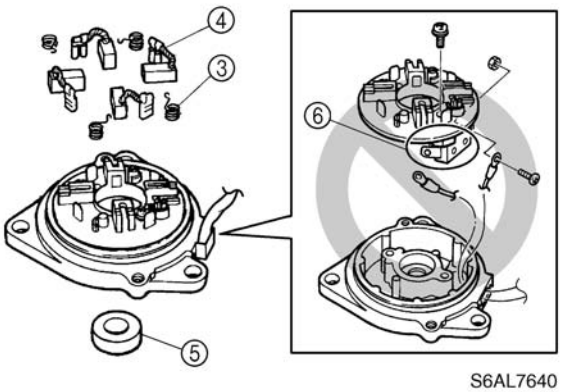


S6AL7630

CAUTION:

Hold the end of the armature shaft with a pair of pliers as shown, and then remove the armature together with the PTT motor base assembly, otherwise the armature could separate from the base assembly due to the magnetic force of the stator ② and damage the brushes.

3. Remove the springs ③, brushes ④, and oil seal ⑤ from the PTT motor base assembly.



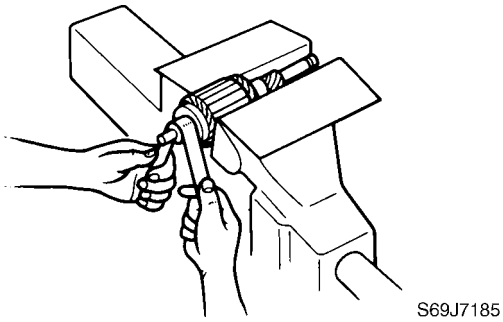
S6AL7640

CAUTION:

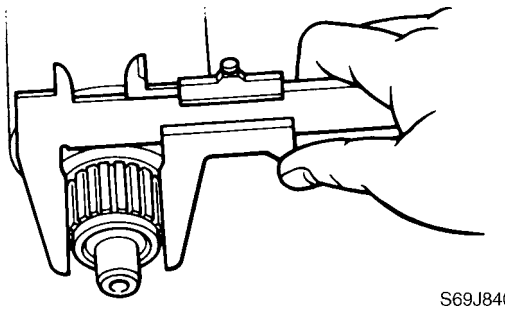
Do not disassemble the PTT motor assembly, otherwise the circuit breaker ⑥ may be damaged.

Checking the PTT motor

1. Check the commutator. Clean with 600–grit sandpaper and compressed air if dirty.


S69J7185

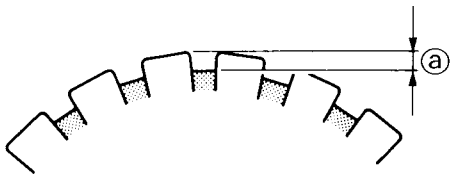
2. Measure the commutator diameter. Replace the armature if below specification.


S69J8400

Motor commutator standard diameter:
23.0 mm (0.91 in)
Wear limit: 22.0 mm (0.87 in)

7

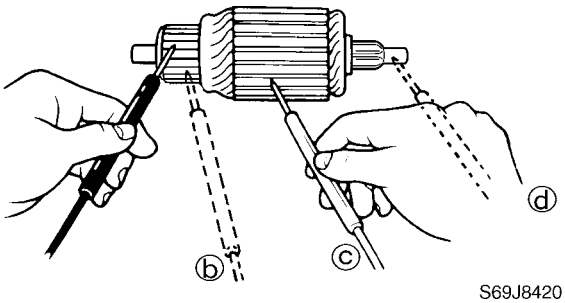
3. Measure the commutator undercut ⓐ. Replace the armature if below specification.



S69J8410

Motor commutator standard undercut ⓐ:
1.40 mm (0.055 in)
Wear limit: 0.90 mm (0.035 in)

4. Check the armature for continuity. Replace the armature if out of specifications.



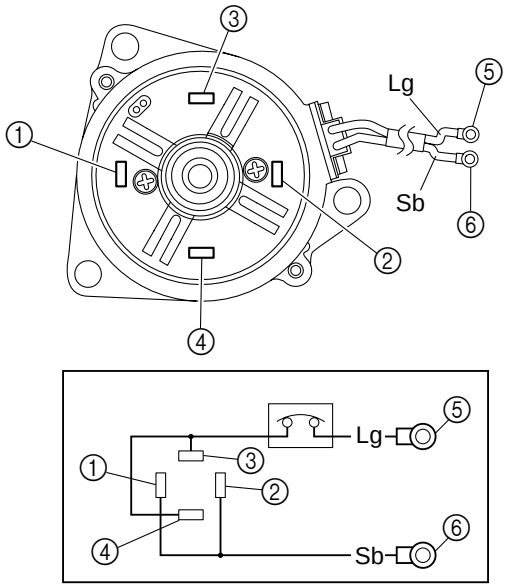
S69J8420

Armature continuity

Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

Checking the brush

1. Check the PTT motor base assembly for continuity. Replace the PTT motor base assembly if out of specification.

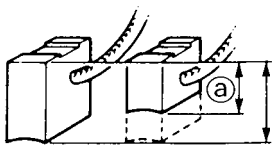


S6AL7650

PTT motor base assembly continuity

Terminal ①–② Terminal ③–④ Terminal ①–⑥ (Sb) Terminal ②–⑥ (Sb) Terminal ③–⑤ (Lg) Terminal ④–⑤ (Lg)	Continuity
For all terminal combinations not listed above.	No continuity

2. Measure the length of each brush. Replace the brushes if below specification.



S69J8430

Motor brush standard length:
11.5 mm (0.45 in)
Wear limit ⓐ: 4.5 mm (0.18 in)

3. Check the PTT motor base. Replace the PTT motor base assembly if cracked or damaged.

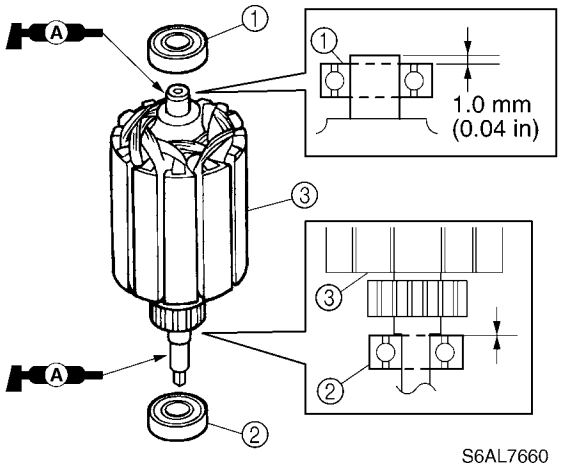
4. Check the bearing and oil seal. Replace the bearing or oil seal if damaged or worn.

Assembling the PTT motor

CAUTION:

Do not allow grease or oil to contact the commutator of the armature.

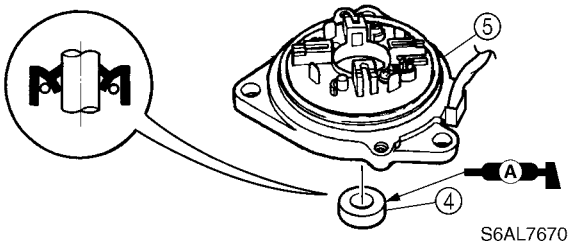
1. Install the bearings ① and ② onto the armature ③.



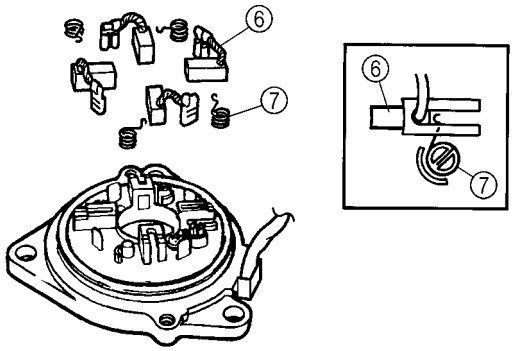
NOTE:

Do not install the bearing ① more than 1.0 mm (0.04 in) past the end of the armature shaft as shown.

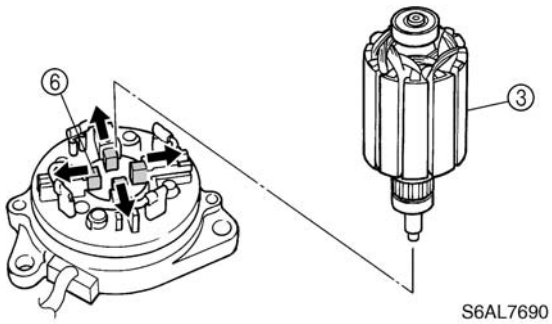
2. Install a new oil seal ④ into the PTT motor base assembly ⑤ as shown.



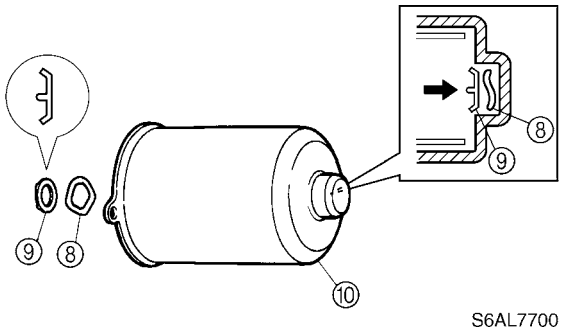
3. Install the brushes ⑥ and springs ⑦ to the PTT motor base assembly as shown.



4. Push the brushes ⑥ into the holders, and then install the armature ③.

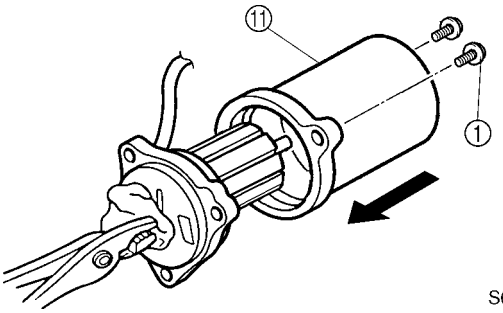


5. Install the wave washer ⑧ and washer ⑨ into the stator ⑩.



7

6. Install a new O-ring and the stator ⑪ to the motor base.

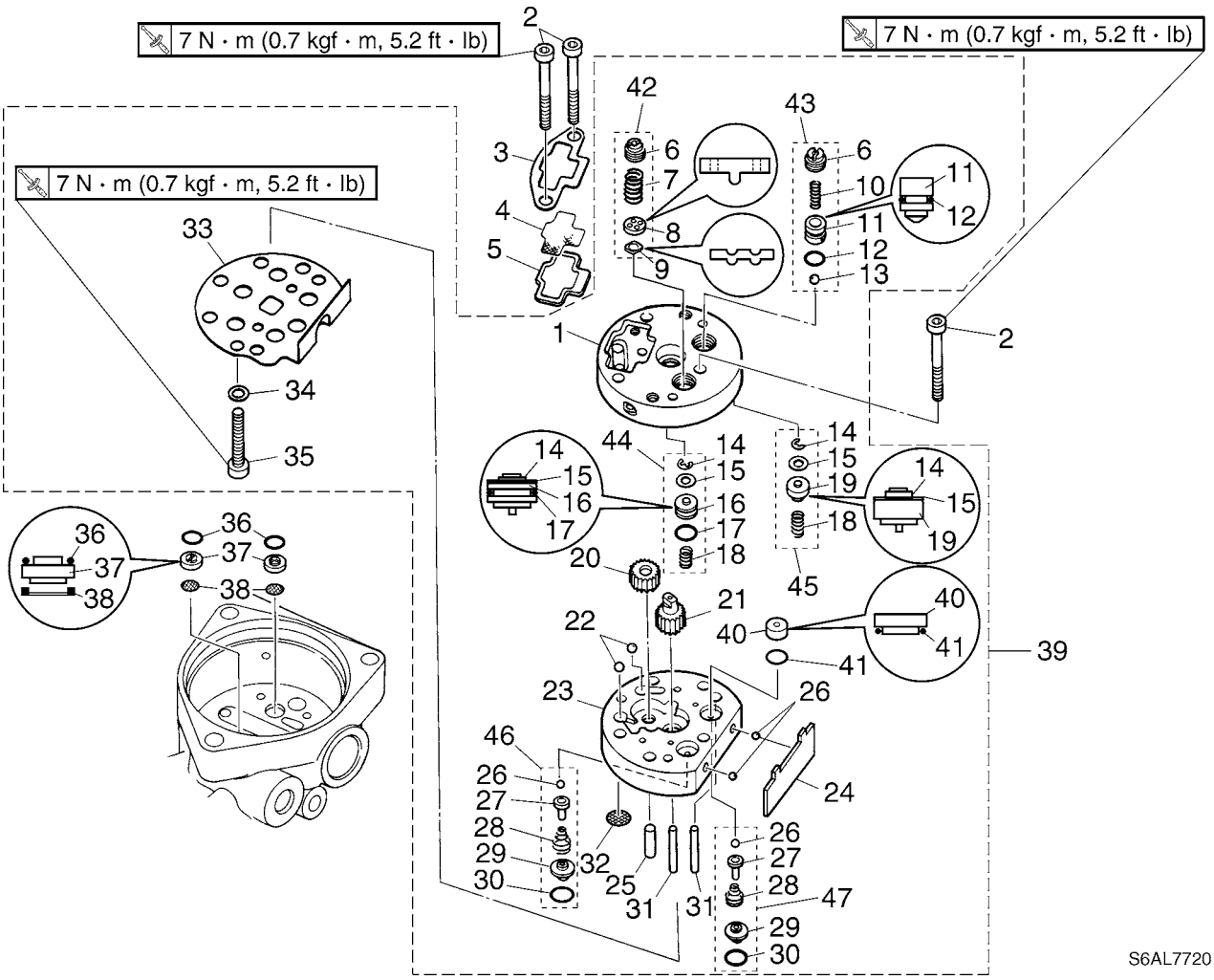


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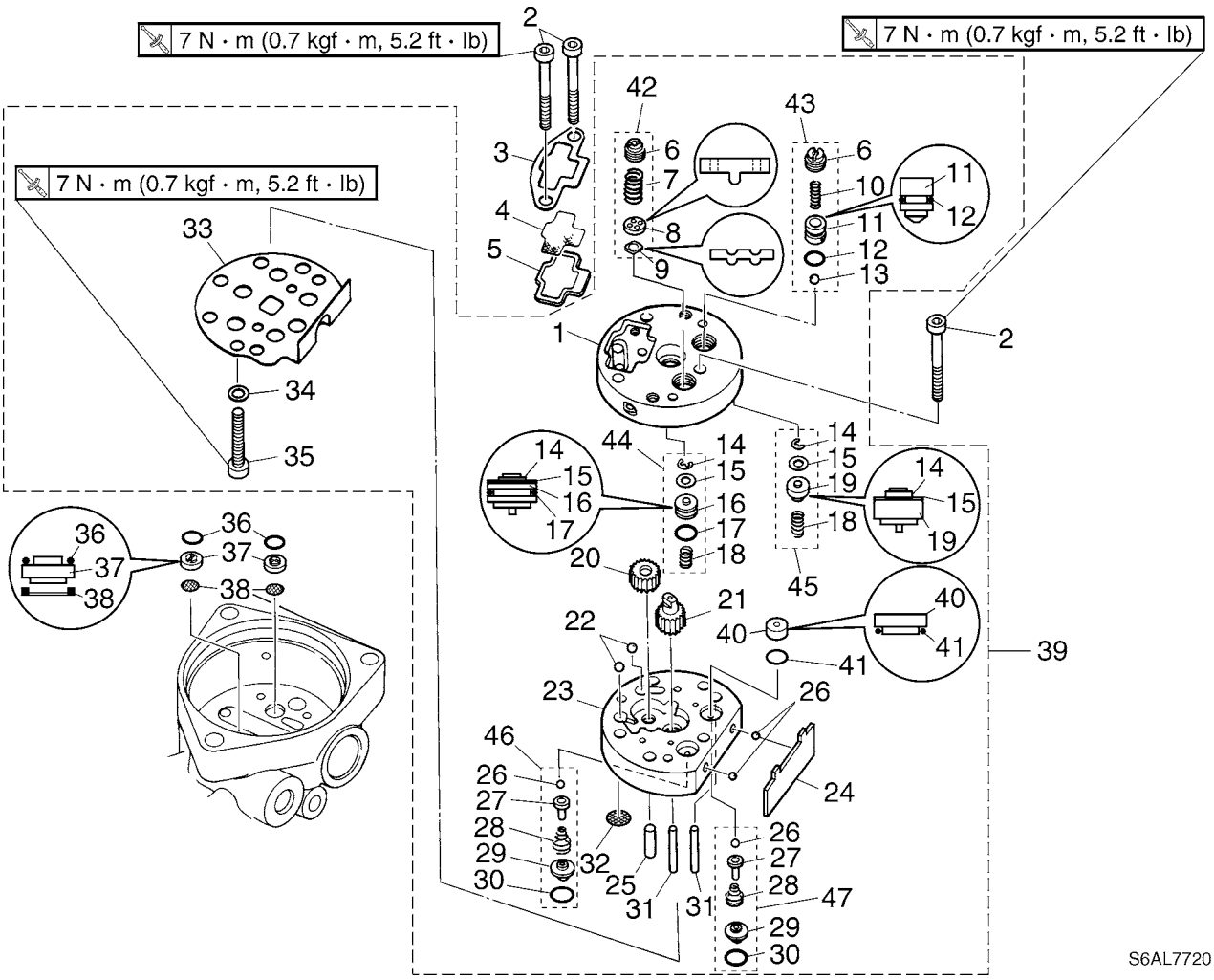
CAUTION:

Hold the end of the armature shaft with a pair of pliers as shown, and then install the armature together with the PTT motor base assembly, otherwise the armature could separate from the base assembly due to the magnetic force of the stator ⑪ and damage the brushes.

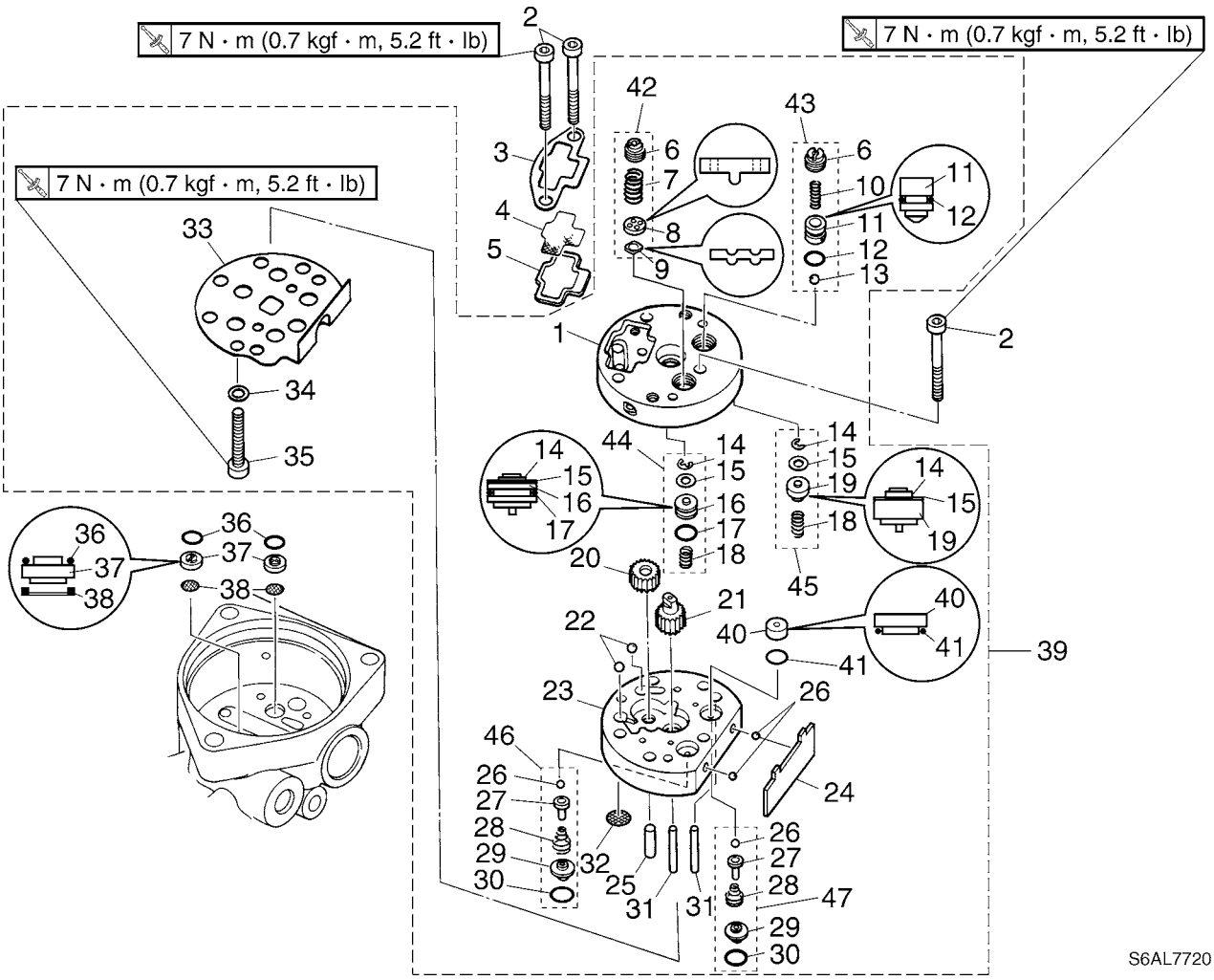
Gear pump



No.	Part name	Q'ty	Remarks
1	Gear housing 1	1	
2	Bolt	3	M5 × 40 mm
3	Plate	1	
4	Filter	1	
5	Plate	1	
6	Valve lock screw	2	
7	Down-relief spring	1	
8	Valve support pin	1	
9	Relief valve seal	1	
10	Up-relief spring	1	
11	Valve support pin	1	
12	O-ring	1	**Not reusable**
13	Ball	1	
14	Circlip	2	
15	Main valve seal	2	
16	Shuttle piston	1	
17	O-ring	1	**Not reusable**



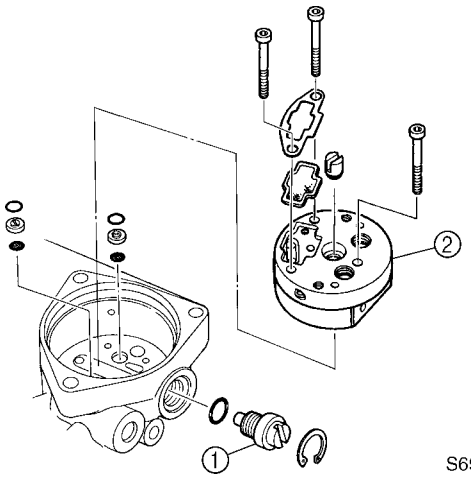
No.	Part name	Q'ty	Remarks
18	Return spring	2	
19	Shuttle piston	1	
20	Driven gear	1	
21	Drive gear	1	
22	Ball	2	
23	Gear housing 2	1	
24	Manual release spring	1	
25	Pin	1	
26	Ball	4	
27	Valve pin	2	
28	Spring	2	
29	Spacer	2	
30	O-ring	2	**Not reusable**
31	Pin	2	
32	Filter	1	
33	Bracket	1	
34	Washer	2	



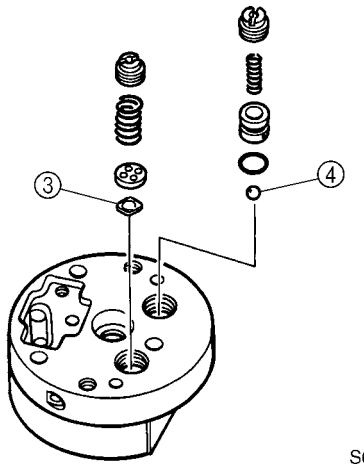
No.	Part name	Q'ty	Remarks
35	Bolt	2	M5 × 25 mm
36	O-ring	2	**Not reusable**
37	Spacer	2	
38	Filter	2	
39	Gear pump assembly	1	
40	Relief valve seat	1	
41	O-ring	1	**Not reusable**
42	Down-relief valve	1	
43	Up-relief valve	1	
44	Down-absorber valve	1	
45	Up-absorber valve	1	
46	Down-main valve	1	
47	Up-main valve	1	

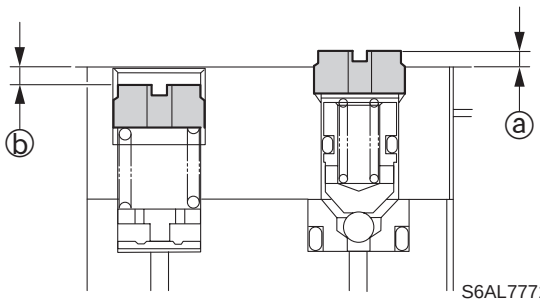
Disassembling the gear pump

1. Remove the manual valve ①, then the gear pump ② and filters.



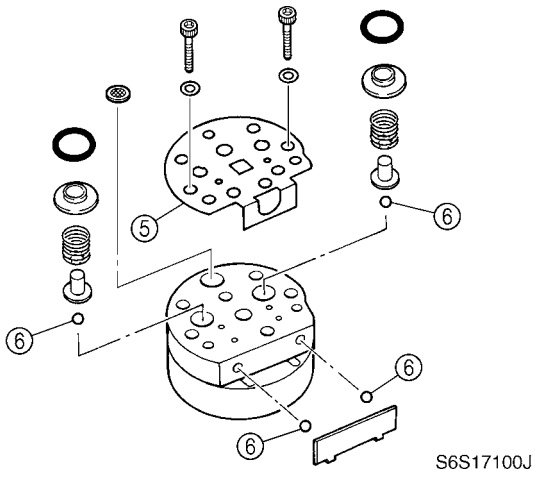
2. Remove the relief valve seal ③ and ball ④.





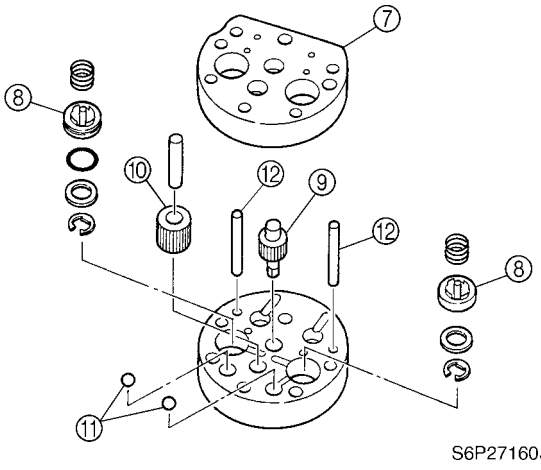
NOTE:
Before removing the relief valves, measure and note the screw height ⓐ and screw depth ⓑ.

3. Remove the bracket ⑤, then the balls ⑥.



4. Remove gear housing 2 ⑦, then the shuttle pistons ⑧.

5. Remove the drive gear ⑨, driven gear ⑩, balls ⑪, and pins ⑫.



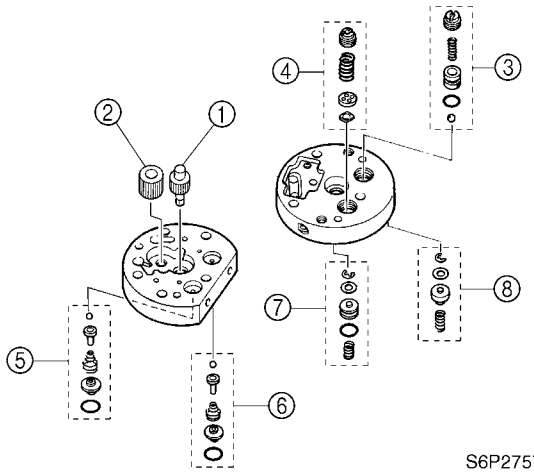
Checking the gear pump

1. Check the drive gear ① and driven gear ②. Replace if damaged or excessive worn.

2. Check the up-relief valve ③ and down-relief valve ④. Clean if there is dirt or residue.

3. Check the main valves ⑤ and ⑥. Clean if there is dirt or residue.

4. Check the absorber valves ⑦ and ⑧. Clean if there is dirt or residue.



Checking the gear pump housing

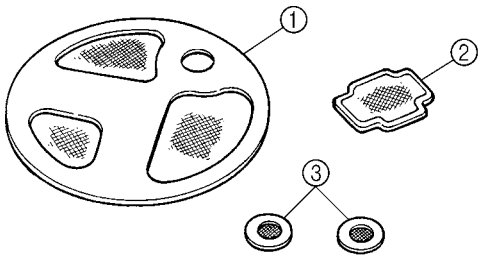
1. Check the gear pump housing. Replace if scratched.

Checking the reservoir

1. Check the reservoir. Replace if cracked or if there is corrosion.

Checking the filter

1. Check the gear pump filters ① and ② and shuttle piston filters ③. Clean if there is dirt or residue.

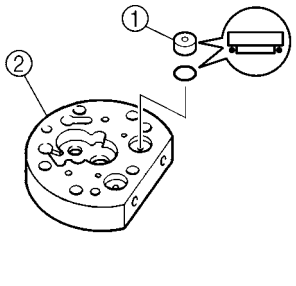


Assembling the gear pump

CAUTION:

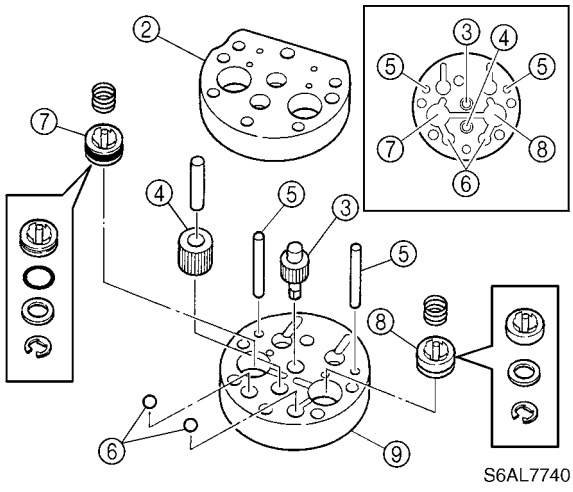
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install the relief valve seat ① into gear housing 2 ②.



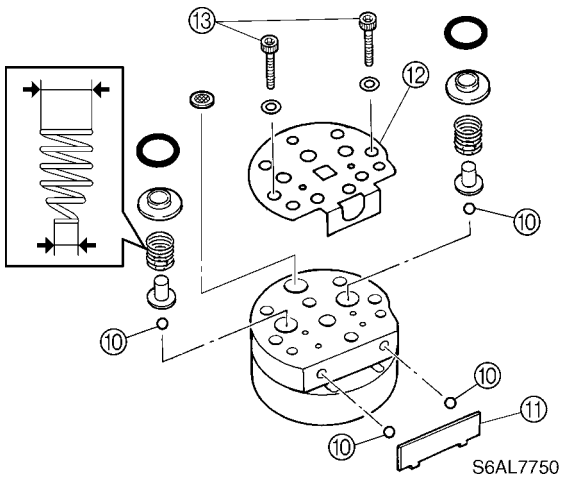
2. Install the drive gear ③, driven gear ④, pins ⑤, balls ⑥, and shuttle pistons ⑦ and ⑧ into gear housing 1 ⑨.

3. Install gear housing 2 ② onto gear housing 1 ⑨.



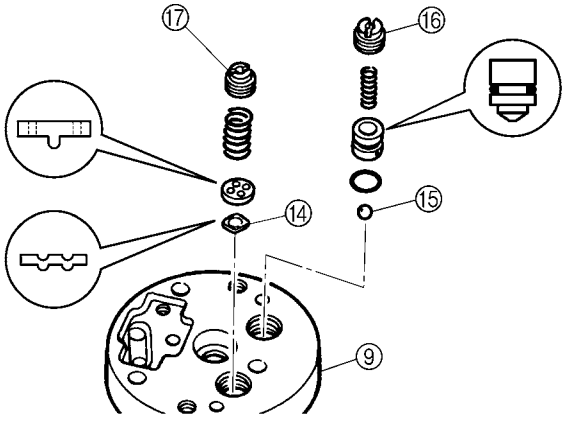
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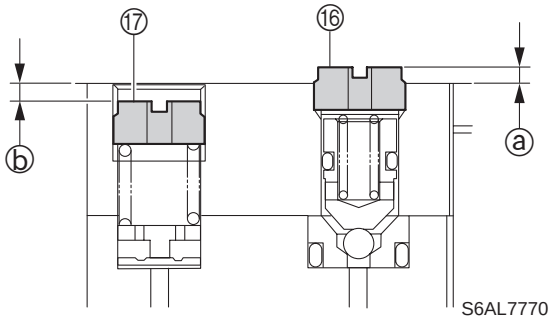
4. Install the balls ⑩, manual release spring ⑪, and bracket ⑫ by installing the bolts ⑬, and tightening them to the specified torque.



Gear pump bracket bolt ⑬:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

5. Install the relief valve seal ⑭ and ball ⑮ into gear housing 1 ⑨, and then install the up-relief lock screw ⑯ and down-relief lock screw ⑰ as shown.



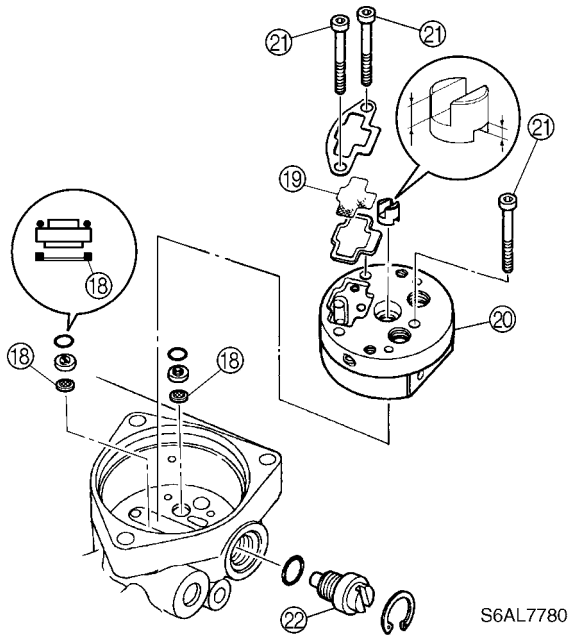


NOTE:
- If reinstalling the removed parts, install them according to the screw height ⓐ and screw depth ⓑ measurements noted before they were removed.
- If installing new parts, install them according to the following reference data for the screw height ⓐ and screw depth ⓑ.

Up-relief lock screw height ⓐ (reference data):
From the top of the gear housing:
1.07–1.27 mm (0.042–0.050 in)
Down-relief lock screw depth ⓑ (reference data):
From the top of the gear housing:
1.95–2.45 mm (0.077–0.096 in)

6. Install the filters ⑱ and ⑲ and gear pump ⑳ by installing the bolts ㉑ and tightening them to the specified torque.

7. Install the manual valve ㉒.

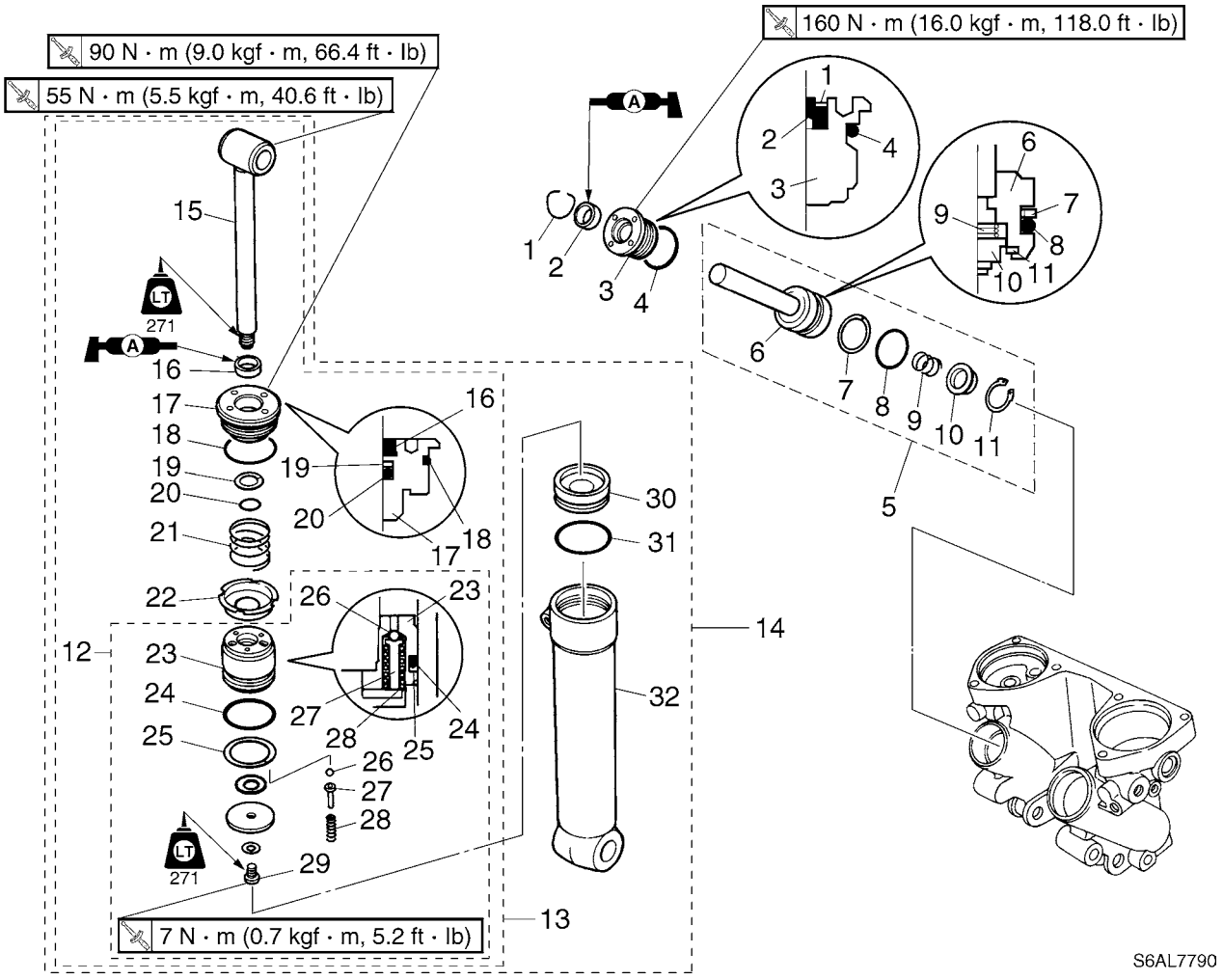


Gear pump bolt ㉑:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

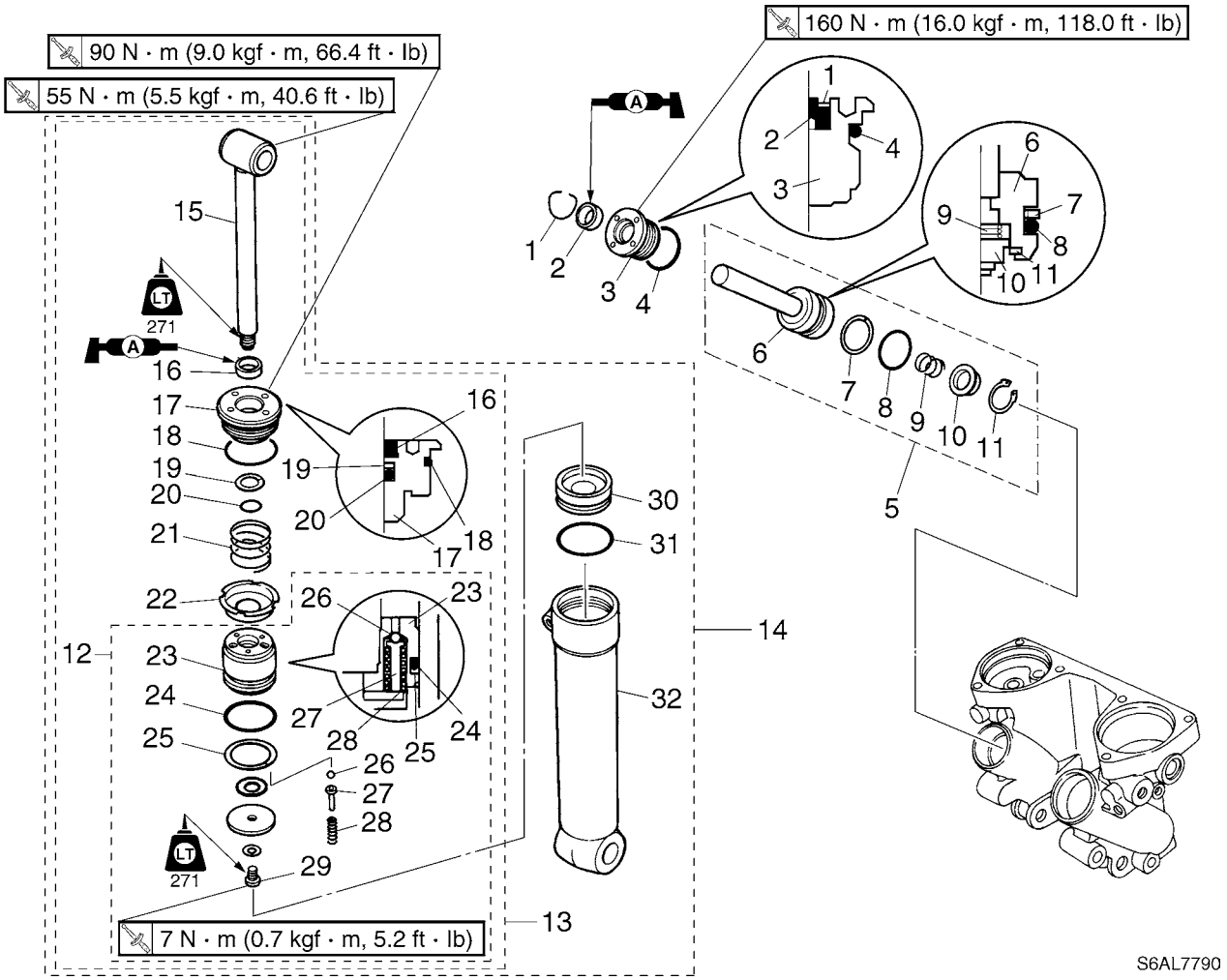
8. Check the hydraulic pressure.

NOTE:
- To check the hydraulic pressure, see Chapter 7, “Checking the hydraulic pressure.”
- If the hydraulic pressure is out of specification, adjust the relief lock screws to adjust the pressure to specification.

Tilt cylinder and trim cylinder



No.	Part name	Q'ty	Remarks
1	Circlip	2	
2	Dust seal	2	**Not reusable**
3	Trim cylinder end screw	2	
4	O-ring	2	**Not reusable**
5	Trim ram assembly	2	
6	Trim piston	2	
7	Backup ring	2	
8	O-ring	2	**Not reusable**
9	Spring	2	
10	Adapter	2	
11	Circlip	2	
12	Tilt piston assembly	1	
13	Tilt ram assembly	1	
14	Power tilt assembly	1	
15	Tilt ram	1	
16	Dust seal	1	**Not reusable**
17	Tilt cylinder end screw	1	

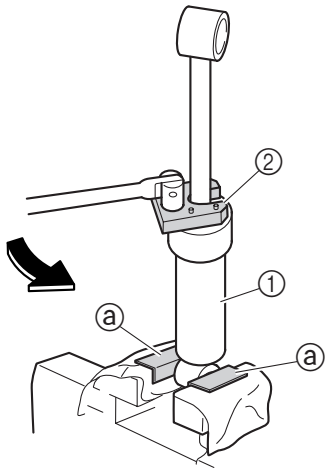


No.	Part name	Q'ty	Remarks
18	O-ring	1	**Not reusable**
19	Backup ring	1	
20	O-ring	1	**Not reusable**
21	Spring	1	
22	Adapter	1	
23	Tilt piston	1	
24	O-ring	1	**Not reusable**
25	Backup ring	1	
26	Ball	5	
27	Pin	5	
28	Spring	5	
29	Bolt	1	M6 × 10 mm/T30
30	Free piston	1	
31	O-ring	1	**Not reusable**
32	Tilt cylinder	1	

Disassembling the tilt cylinder and trim cylinder

1. Hold the tilt cylinder ① in a vise using aluminum plates ⓐ on both sides.

2. Loosen the tilt cylinder end screw, and then remove the tilt ram assembly.



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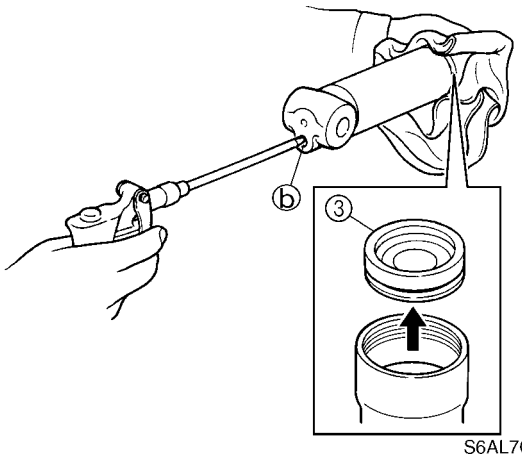
⚠ WARNING

Make sure that the ram are fully extended before removing the end screw.

Cylinder-end screw wrench ②: 90890-06568

3. Drain the PTT fluid.

4. Blow compressed air through the hole ⓑ to remove the free piston ③.



S6AL7C09

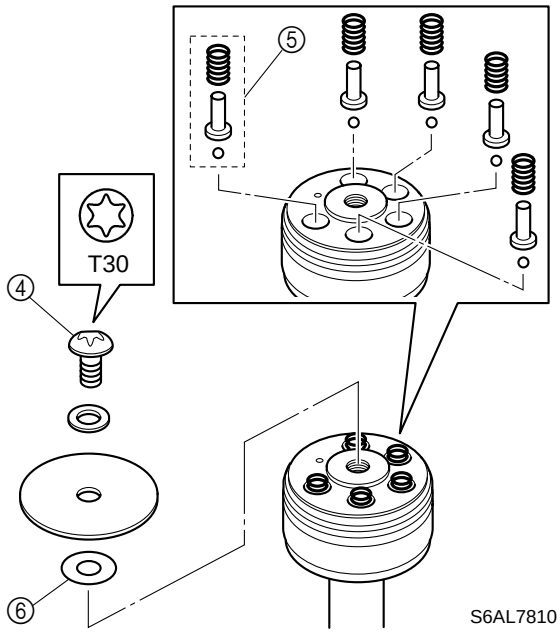
⚠ WARNING

Never look into the tilt cylinder opening when removing the free piston. The free piston and PTT fluid can be forcefully expelled out.

NOTE:
Be sure to cover the opposite end of the tilt cylinder with a rag.

5. Hold the tilt ram end in a vise using aluminum plates on both sides.

6. Remove the bolt ④, and then remove the piston absorber valves ⑤.

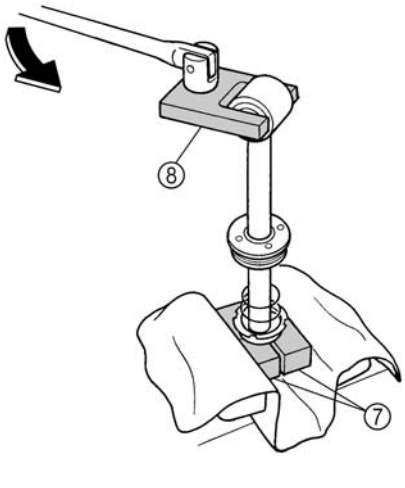


S6AL7810

NOTE:
Be sure to keep original shim(s) ⑥.

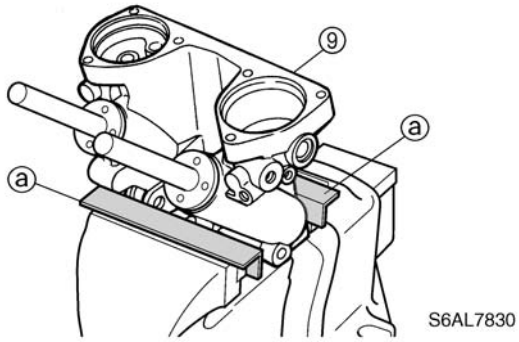
7. Hold the tilt piston in a vise using the special service tool ⑦ on both sides.

8. Remove the tilt piston from the tilt ram assembly.

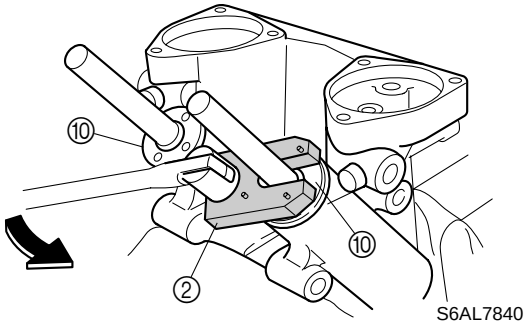


	PTT piston vice attachment ⑦: 90890-06572 Tilt rod wrench ⑧: 90890-06569

9. Hold the PTT body ⑨ in a vise using aluminum plates ⓐ on both sides.



10. Loosen the trim cylinder end screws ⑩, and then remove them.

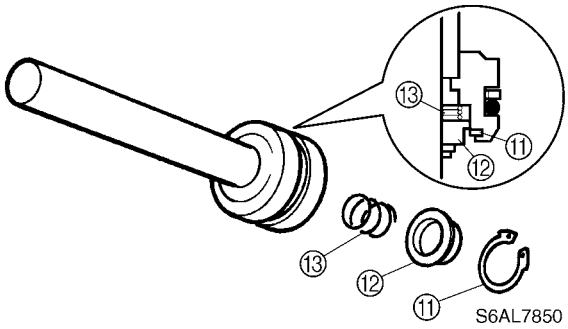


	Cylinder-end screw wrench ②: 90890-06568

11. Remove the trim ram assemblies.

12. Drain the PTT fluid.

13. Remove the circlip ⑪, adapter ⑫, and spring ⑬ from the trim pistons.



7

Checking the tilt cylinder and trim cylinder

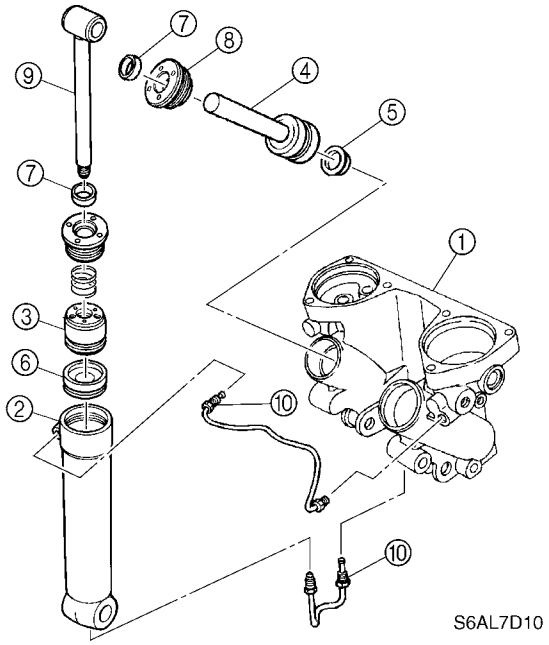
1. Check the PTT body ① and tilt cylinder ②. Replace the PTT body ① or tilt cylinder ② if cracked or if there is corrosion.

2. Check the inner surface of the PTT body ① and tilt cylinder ②. Replace the PTT body ① or tilt cylinder ② if scratched.

3. Check the outer surface of the tilt piston ③, trim piston ④, adapter ⑤, free piston ⑥, and dust seals ⑦ of end screw. Replace the tilt piston ③, trim piston ④, adapter ⑤, free piston ⑥ or dust seals ⑦ if scratched.

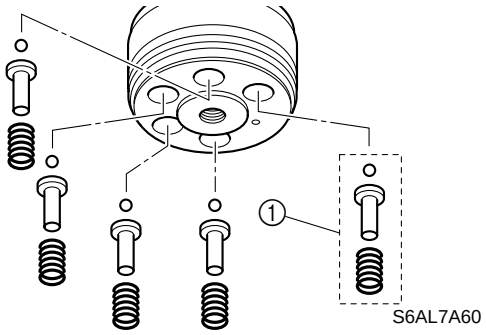
4. Check the trim rams ⑧ and tilt ram ⑨. Polish with 400–600–grit sandpaper if there is light rust or replace if bent or if there is excessive corrosion.

5. Check the pipes ⑩. Replace the pipes ⑩ if cracked or if there is corrosion.



Checking the valve

1. Check the tilt piston absorber valves ①. Clean the tilt piston absorber valves ① if there is dirt or residue.

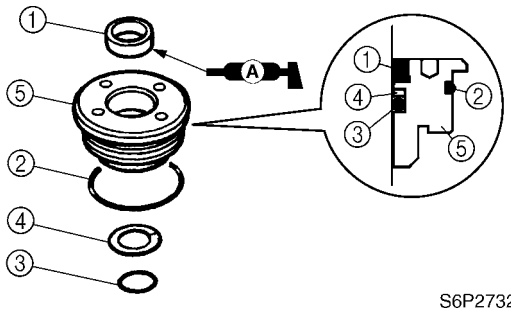


Assembling the tilt ram

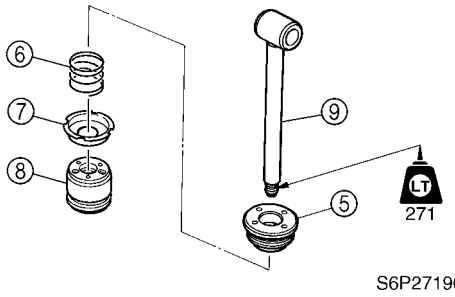
CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install a new dust seal ①, new O-rings ② and ③, and the backup ring ④ into the tilt cylinder end screw ⑤.

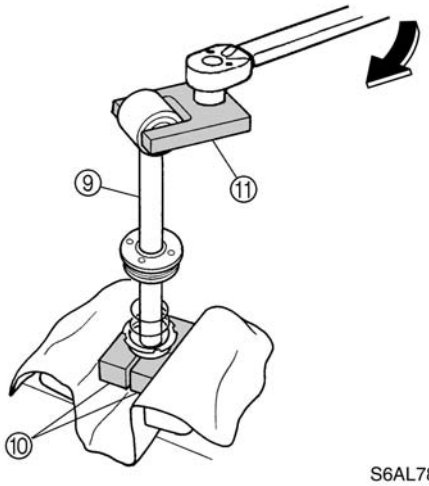


2. Install the tilt cylinder end screw ⑤, spring ⑥, adapter ⑦, and tilt piston ⑧ to the tilt ram ⑨.



3. Hold the tilt piston in a vise using the special service tool ⑩ on both sides.

4. Tighten the tilt ram ⑨ to the specified torque.



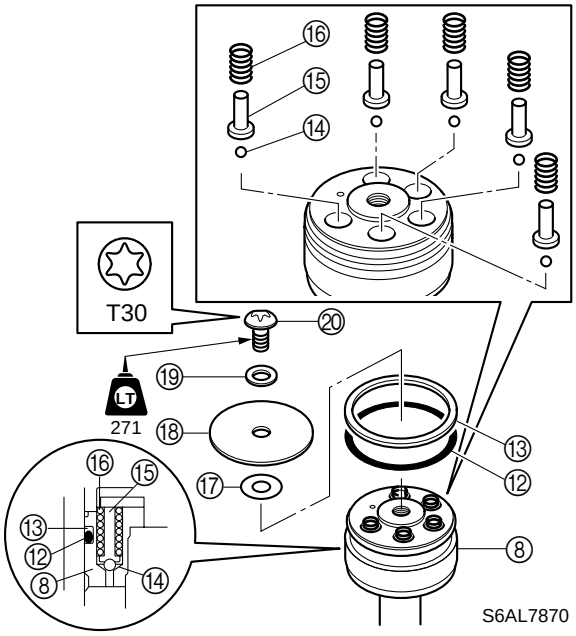
PTT piston vice attachment ⑩:
90890-06572
Tilt rod wrench ⑪: 90890-06569

Tilt ram ⑨:
55 N·m (5.5 kgf·m, 40.6 ft·lb)

5. Install a new O-ring ⑫ and the backup ring ⑬ onto the tilt piston ⑧.

6. Install the balls ⑭, absorber valve pins ⑮, and springs ⑯ as shown.

7. Install the shim(s) ⑰, plate ⑱, washer ⑲, and bolt ⑳ to the tilt piston ⑧, and then tighten the bolt to the specified torque.



NOTE:
- Replace the tilt piston assembly if replacing the tilt piston ⑧. The shim(s) ⑰ are not available as individual parts.
- If the tilt piston ⑧ was not replaced, use the original shim(s) ⑰.

Tilt piston bolt ⑳:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

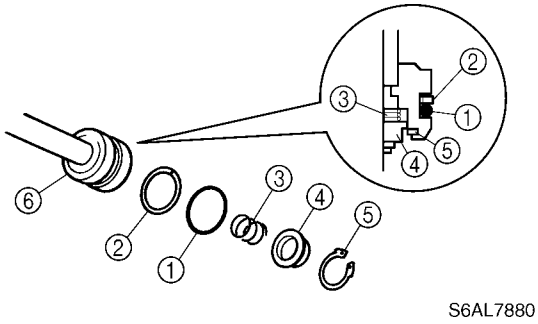
7

Assembling the trim ram

CAUTION:

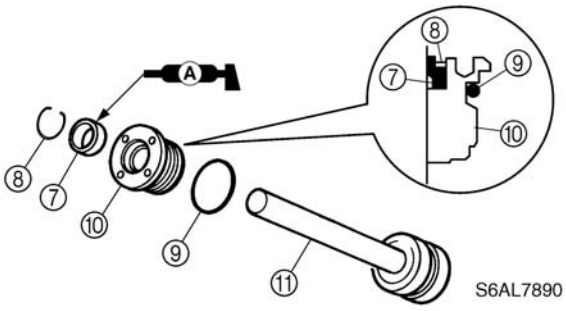
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install a new O-ring ①, the backup ring ②, the spring ③, the adapter ④, and the circlip ⑤ to the trim piston ⑥.



2. Install a new dust seal ⑦, the circlip ⑧, and a new O-ring ⑨ to the trim cylinder end screw ⑩.

3. Install the trim cylinder end screw ⑩ onto the trim ram ⑪.



Installing the tilt cylinder

CAUTION:

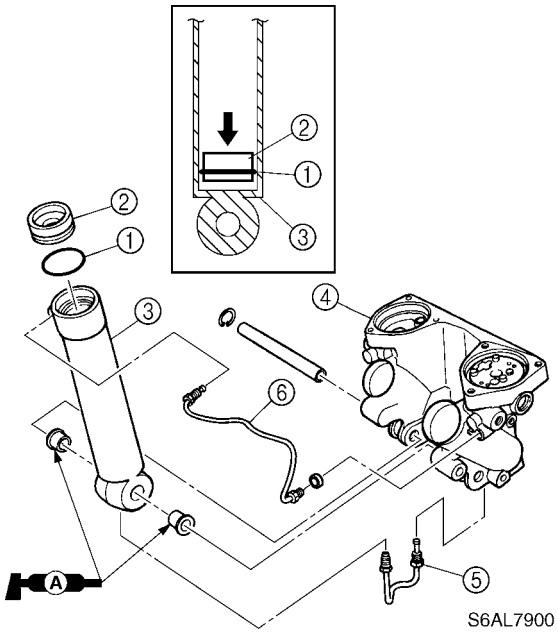
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install a new O-ring ① to the free piston ②.

2. Push the free piston ② into the tilt cylinder ③ until it bottoms out.

3. Install the tilt cylinder ③ to the PTT body ④.

4. Install the pipes ⑤ and ⑥, and then tighten the pipe joints to the specified torque.



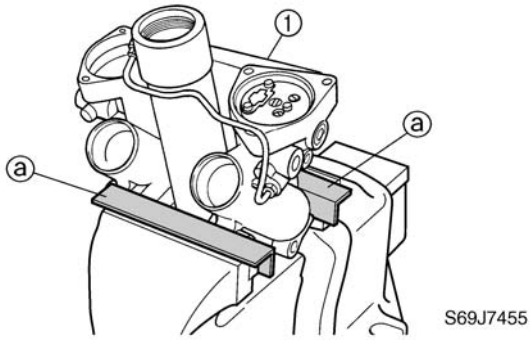
Pipe joint:
15 N·m (1.5 kgf·m, 11.1 ft·lb)

Installing the trim ram

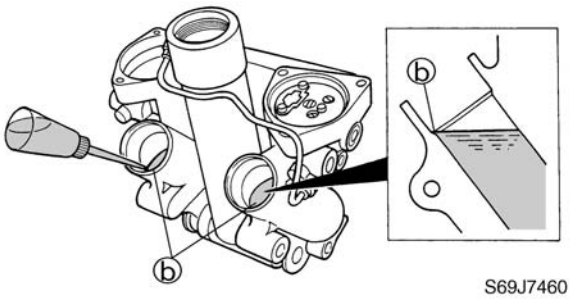
CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Hold the PTT body ① in a vise using aluminum plates ⓐ on both sides.

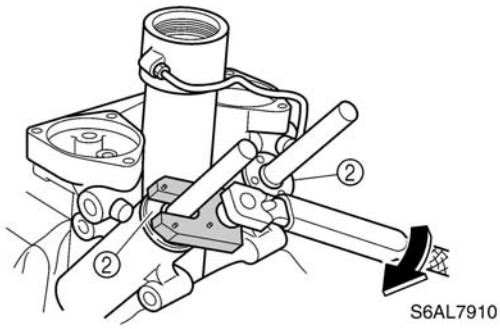


2. Fill the trim cylinders with the recommended fluid to the correct level ⓑ as shown.



Recommended PTT fluid:
ATF Dexron II

3. Install the trim ram assemblies into the trim cylinders, and then tighten the trim cylinder end screws ② to the specified torque.



⚠ WARNING

Do not push the trim rams down while installing them into the trim cylinders. Otherwise, the PTT fluid may spurt out from the unit.

Cylinder-end screw wrench:
90890-06568

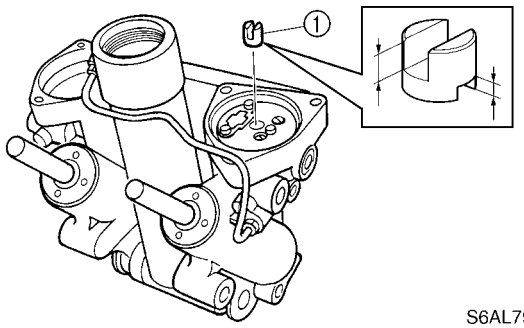
Trim cylinder end screw ②:
160 N·m (16.0 kgf·m, 118.0 ft·lb)

Installing the PTT motor

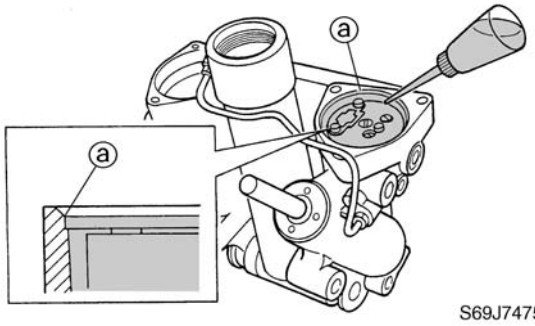
CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install the joint ① into the gear pump.



2. Fill the pump housing with the recommended fluid to the correct level ⓐ as shown.



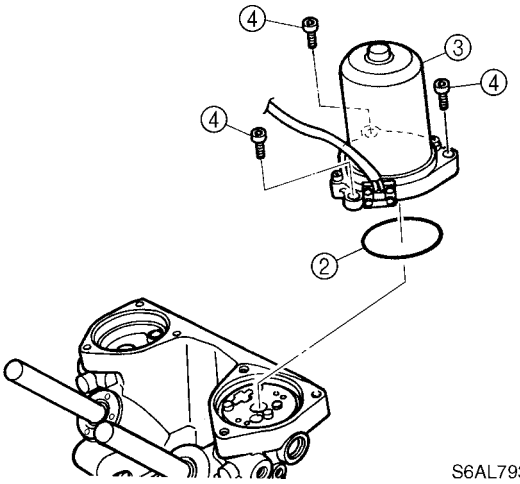
Recommended PTT fluid:
ATF Dexron II

7

3. Remove all of the air bubbles with a syringe or suitable tool.

NOTE:
Turn the joint ① with a screwdriver, and then remove any air between the pump gear teeth.

4. Install a new O-ring ② and the PTT motor ③, and then tighten the bolts ④ to the specified torque.



S6AL7930

NOTE:
Align the armature shaft with the recess in the joint.

PTT motor mounting bolt ④:
19 N·m (1.9 kgf·m, 14.0 ft·lb)

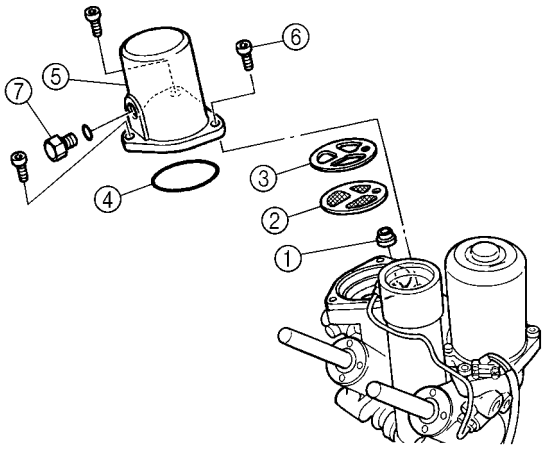
Installing the reservoir

CAUTION:
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install the spacer ①, filter ② and sheet ③ to the PTT body.

2. Install a new O-ring ④ and the reservoir ⑤, and then tighten the bolts ⑥ to the specified torque.

3. Install a new O-ring and the reservoir cap ⑦, and then tighten the reservoir cap to the specified torque.



S6AL7940

Reservoir mounting bolt ⑥:
19 N·m (1.9 kgf·m, 14.0 ft·lb)
Reservoir cap ⑦:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Installing the tilt ram

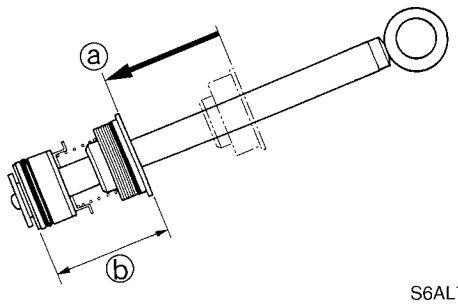
CAUTION:
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Place the tilt cylinder end screw at the position ⓐ (bottom of the tilt ram).

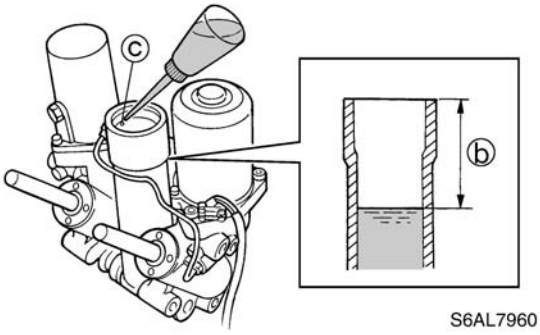
2. Fill the tilt cylinder with the recommended fluid to the correct level ⓑ as shown.

Recommended PTT fluid:
ATF Dexron II

3. Add a small amount of the recommended fluid through the PTT body hole ⓒ as shown.

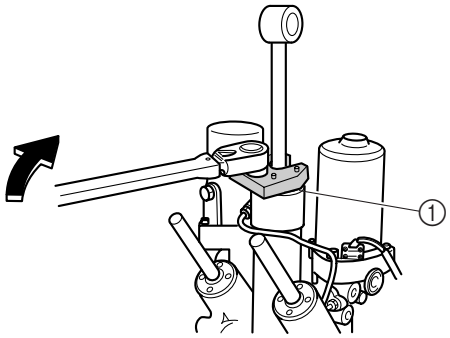


S6AL7950



S6AL7960

4. Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw ① to the specified torque.



S6AL7970

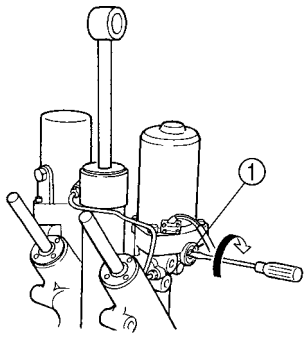
NOTE:
Place the tilt cylinder end screw at the position ⓐ and install the tilt piston assembly into the tilt cylinder.

	Cylinder-end screw wrench: 90890-06568

	Tilt cylinder end screw ①: 90 N·m (9.0 kgf·m, 66.4 ft·lb)

Bleeding the PTT unit

1. Place the PTT unit in an upright position.
2. Close the manual valve ① by turning it clockwise.



S6AL7C01

	Manual valve ①: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

3. Remove the reservoir cap, and then check the fluid level in the reservoir.

⚠ WARNING

Make sure that the trim and tilt rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.

NOTE:
If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole.

4. If fluid is below the correct level, add recommended fluid.

	Recommended PTT fluid: ATF Dexron II

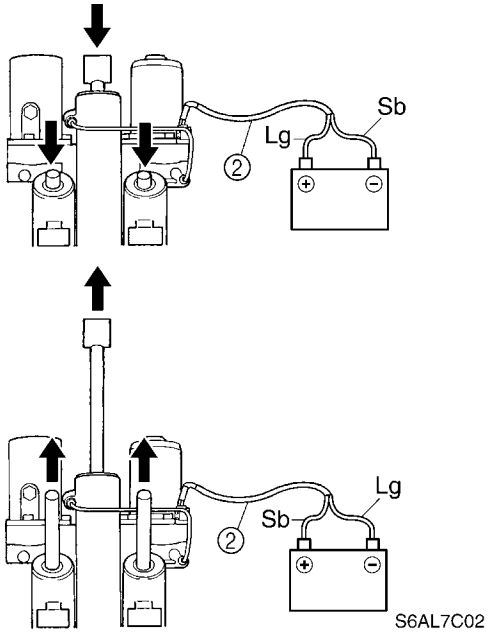
5. Install the reservoir cap, and then tighten it to the specified torque.

	Reservoir cap: 7 N·m (0.7 kgf·m, 5.2 ft·lb)

7

6. Connect the PTT motor leads ② to the battery terminals to fully retract the trim and tilt rams.

7. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



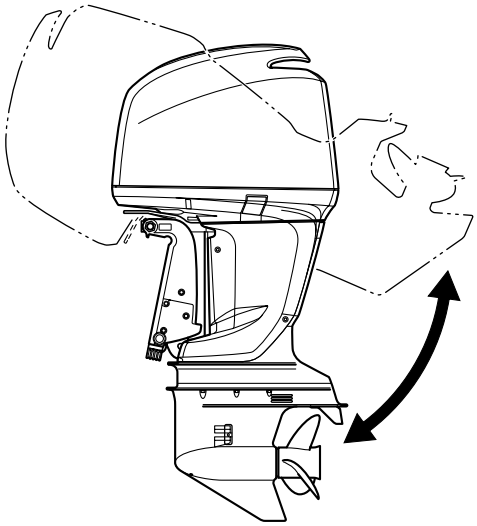
Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

NOTE:
If the rams do not move up and down easily, push and pull on the trim and tilt rams to assist operation.

8. Check the fluid level when the trim and tilt rams are fully extended. If the fluid level is low, add sufficient fluid, and then repeat steps 6–7.

Bleeding the PTT unit (built-in)

1. Push the PTT switch to fully tilt the outboard motor up and down 4 to 5 times.



NOTE:
Connect the PTT motor leads directly to the battery terminals when the power unit is not installed. To connect the PTT motor leads, see Chapter 7, “Bleeding the PTT unit.”

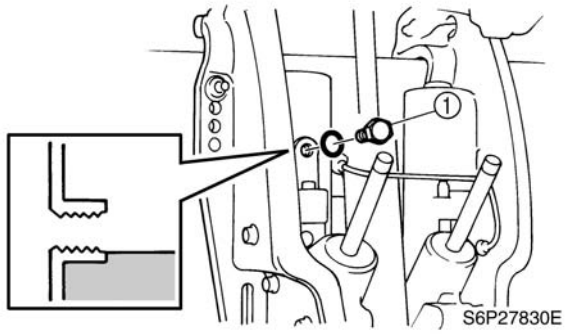
2. Let the fluid settle for 5 minutes with the outboard motor tilted down.

3. Push the PTT switch to fully tilt the outboard motor up.

4. Support the outboard motor with the tilt stop lever, and then let the fluid settle for 5 minutes.

⚠ WARNING
After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.

5. Remove the reservoir cap ①, and then check the fluid level in the reservoir.



NOTE:
If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole when the cap is removed.

6. If the fluid is below the correct level, add recommended fluid.

Recommended PTT fluid:
ATF Dexron II

7. Install a new O-ring and the reservoir cap ①, and then tighten the reservoir cap to the specified torque.

NOTE:
Repeat steps 1–7 until the fluid remains at the correct level.

Reservoir cap ①:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

PTT electrical system

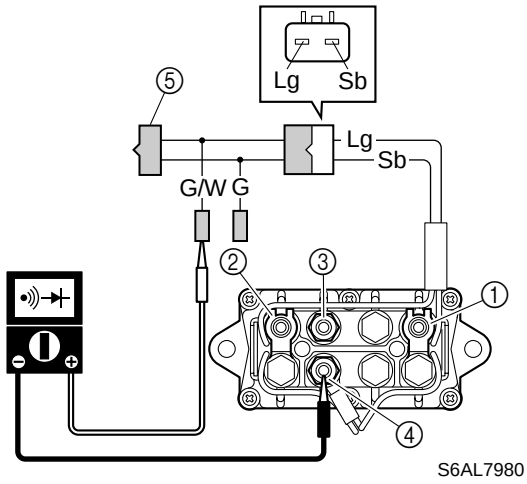
Checking the fuse

1. Check the fuse for continuity. Replace the fuse if there is no continuity.

NOTE:
For the location of the fuse, see Chapter 8, “Fuse holder.”

Checking the PTT relay

1. Using the special service tool check the PTT relay for continuity. Replace the PTT relay if out of specification.

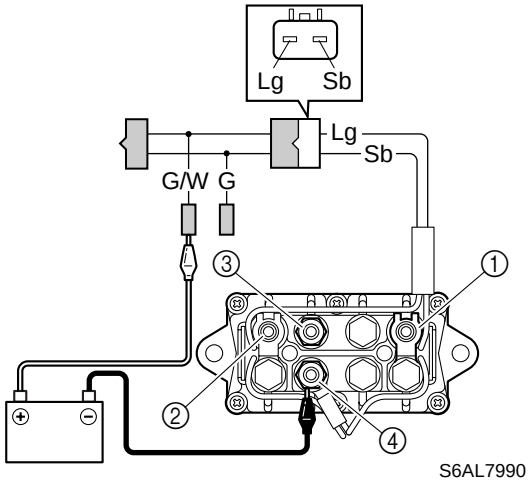


Test harness (2 pins): 90890-06867

PTT relay continuity	
Sky blue (Sb) – Terminal ④ Light green (Lg) – Terminal ④	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

7

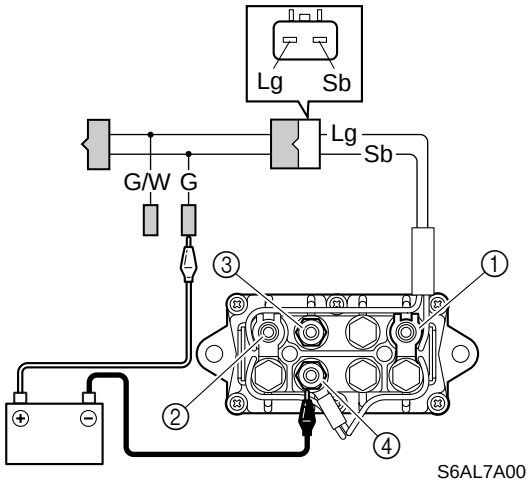
2. Connect the positive battery lead to the light green (Lg) lead, and the negative battery lead to the terminal ④ as shown, and then check the PTT relay for continuity. Replace the PTT relay if out of specification.



S6AL7990

PTT relay continuity	
Terminal ① – Terminal ③	Continuity
Terminal ① – Terminal ② Terminal ② – Terminal ③	No continuity

3. Connect the positive battery lead to the sky blue (Sb) lead, and the negative battery lead to the terminal ④ as shown, and then check the PTT relay for continuity. Replace the PTT relay if out of specification.

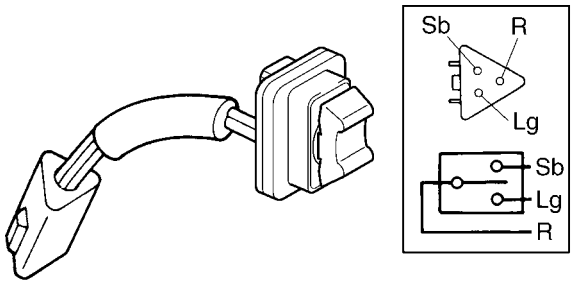


S6AL7A00

PTT relay continuity	
Terminal ② – Terminal ③	Continuity
Terminal ① – Terminal ② Terminal ① – Terminal ③	No continuity

Checking the PTT switch

1. Check the PTT switch for continuity. Replace the PTT switch if out of specification.

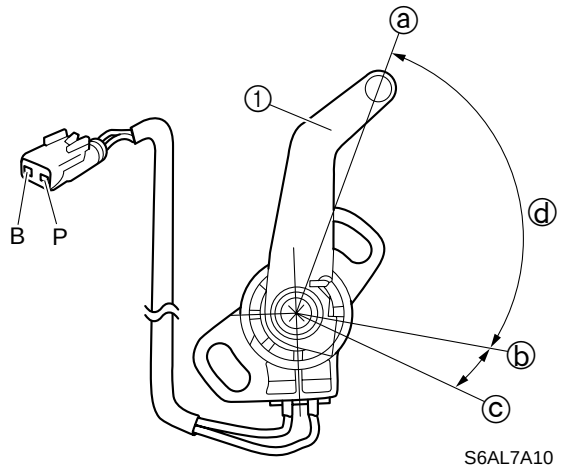


S6AL7C03

	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Light green (Lg)
Up	○	○	
Free			
Down		○	○

Checking the trim sensor

1. Measure the trim sensor resistance. Replace the trim sensor if out of specification.



S6AL7A10

NOTE:

- Turn the trim sensor lever ① from ⓐ to ⓒ and measure the resistance as it gradually changes.
- The position ⓑ is the trim sensor lever position when the outboard motor is tilted down. To adjust the trim sensor, see Chapter 7, “Adjusting the trim sensor.”
- The trim sensor resistance will be lower at the position ⓒ than at the position ⓑ.
- The range ⓓ is the trim and tilt operation range.

Trim sensor resistance:
Pink (P) – Black (B)
247.6–387.6 Ω at ⓐ
9–11 Ω at ⓑ

7

Electrical system

Checking the electrical component 8-1
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8

Checking the electrical component

Checking using the YDIS

When checking the electronic throttle valve, accelerator position sensor, oil control valve, or each sensor, use the YDIS.

When deleting the diagnosis record in the YDIS, be sure to check the time that the trouble codes were detected.

When checking the input voltage of a part, the coupler or connector must be disconnected. As a result, the ECM determines that the part is disconnected and a trouble code is detected. Therefore, be sure to delete the diagnosis record after checking the input voltage.

Since the main relay comes on for approximately 10 seconds after the start switch is turned to "OFF," the power of the ECM cannot be turned off. Therefore, if the start switch is turned to "ON" within 10 seconds after it was turned to "OFF," the trouble codes cannot be deleted.

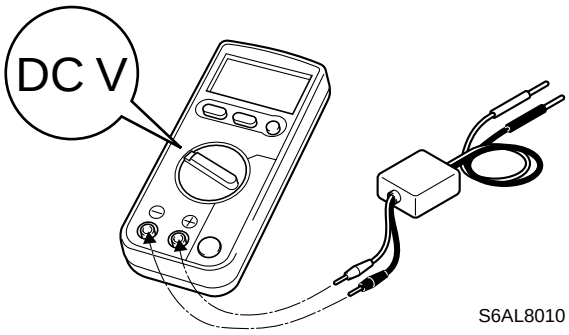
NOTE:

- Before checking the electrical components, make sure that the battery is fully charged.
- The YDIS requires that you use an exclusive communication cable and CD-ROM to connect to a computer. For a description of the communication cable and CD-ROM to be used, see Chapter 9, "YDIS." Also, be sure to check the CD-ROM version before using it.
- To connect the YDIS, see Chapter 9, "YDIS" or the YDIS (Ver. 1.23a or later) Instruction Manual.

YDIS (connecting kit):
60V-85300-02-00
YDIS (CD-ROM, Ver. 1.23a):
60V-WS853-03

Measuring the peak voltage

To check the electrical components or measure the peak voltage, use the special service tools. A faulty electrical component can be easily checked by measuring the peak voltage. The specified engine speed when measuring the peak voltage is effected by many factors such as fouled spark plugs or a weak battery. If one of these factors is present, the peak voltage cannot be measured properly.



S6AL8010

⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital tester leads.

CAUTION:

When testing the voltage between the terminals of an electrical component with the digital tester, do not allow any of the leads to touch any metal parts. If touched, the electrical component can short and be damaged.

NOTE:
- Before measuring the peak voltage, check all wiring for proper connection and corrosion, and check that the battery is fully charged.
- Use peak voltage adapter B with the recommended digital circuit tester.
- Connect the positive pin of peak voltage adapter B to the positive terminal of the digital tester, and the negative pin to the negative terminal.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.

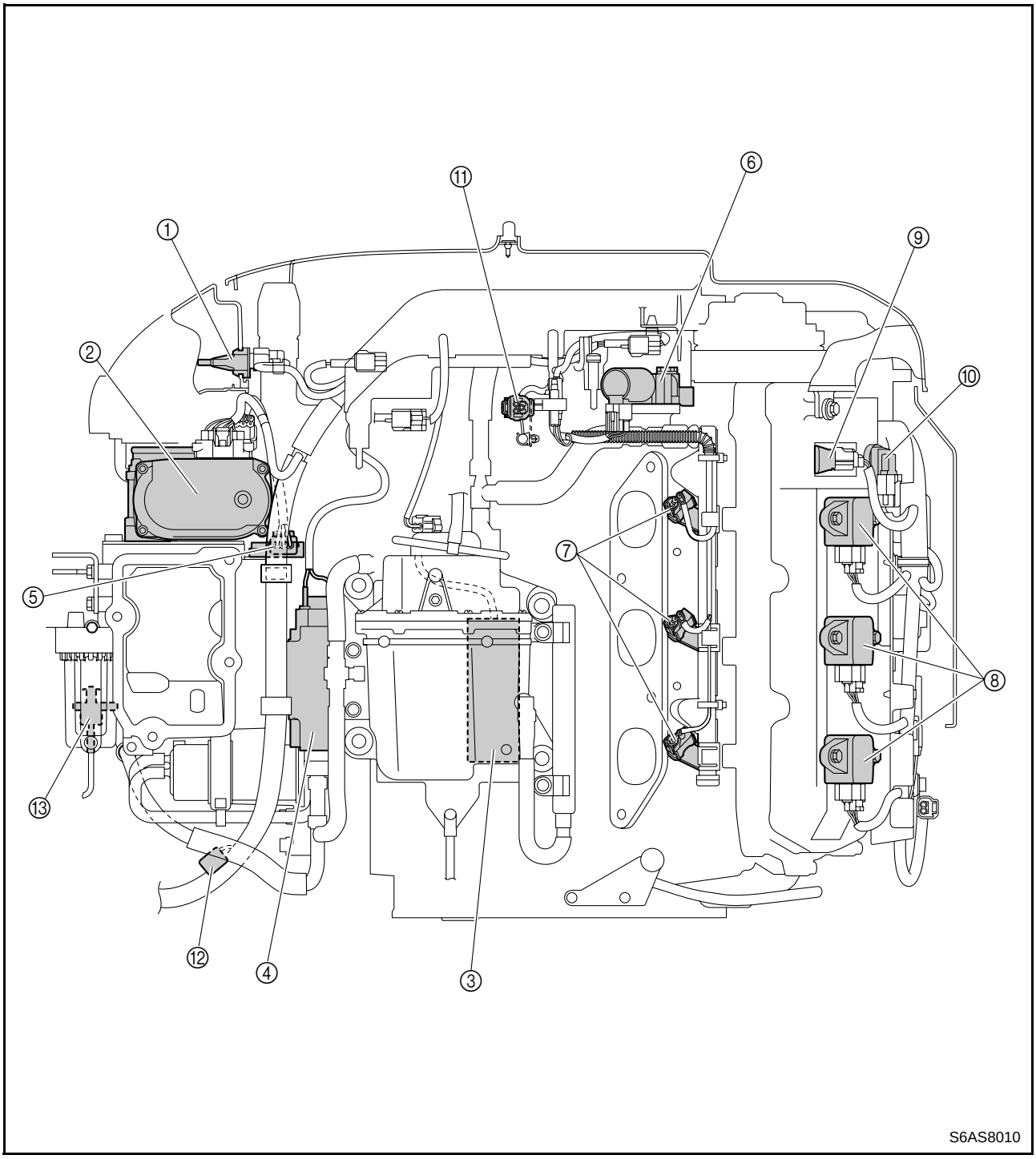


Digital circuit tester: 90890-03174
Peak voltage adapter B:
90890-03172

8

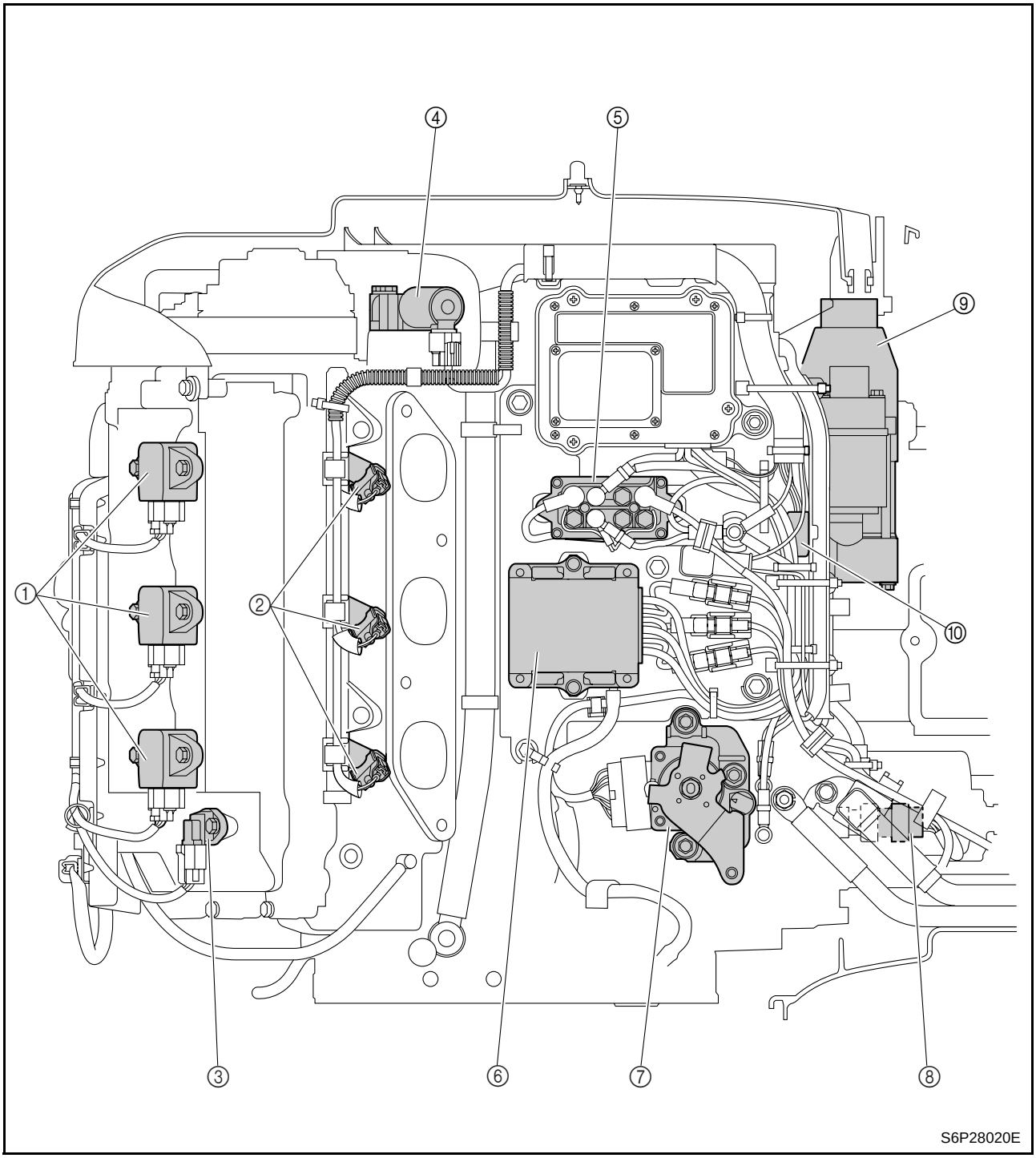
Electrical component

Port view



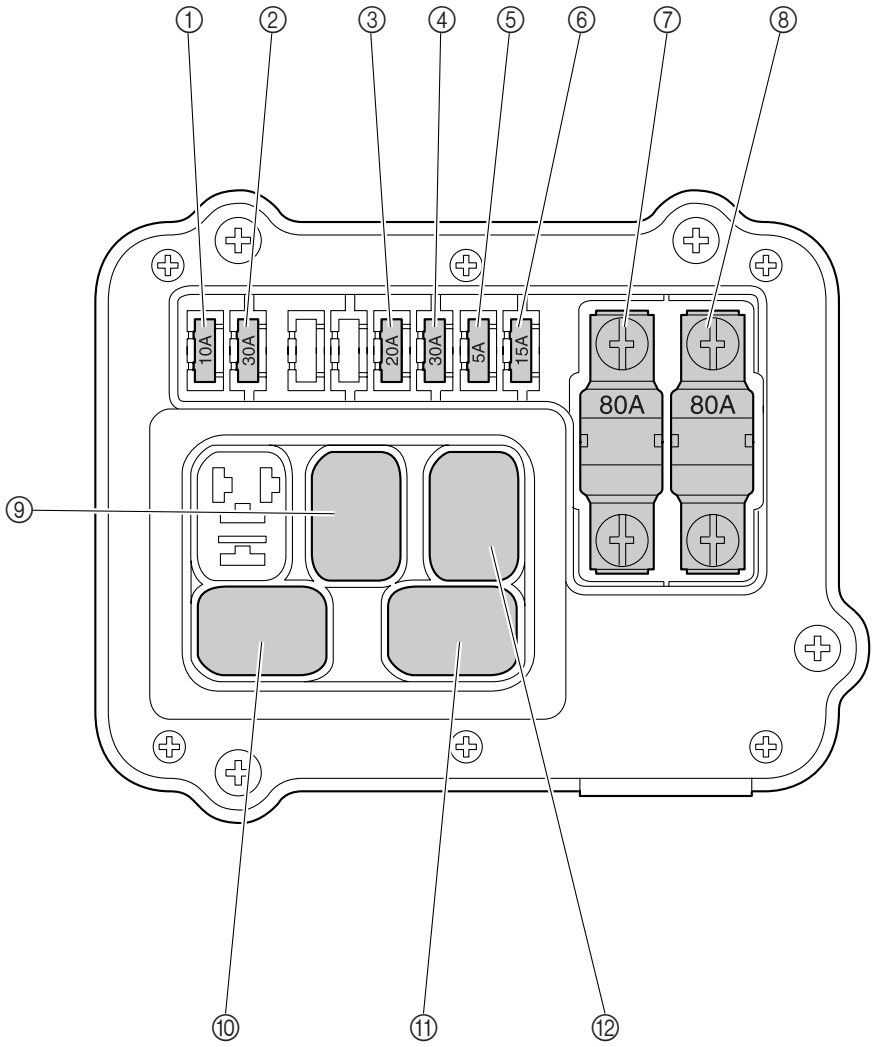
① Intake air temperature sensor
② Electronic throttle valve assembly
③ High-pressure fuel pump
④ Low-pressure fuel pump
⑤ Intake air pressure sensor
⑥ Oil control valve (PORT)
⑦ Fuel injector
⑧ Ignition coil
⑨ Cam position sensor (PORT IN)
⑩ Cam position sensor (PORT EX)
⑪ 3-pin communication coupler
⑫ Condenser assembly (connect to the intake air pressure sensor)
⑬ Water detection switch (in fuel filter)

Starboard view



① Ignition coil
② Fuel injector
③ Cam position sensor (STBD IN)
④ Oil control valve (STBD)
⑤ PTT relay
⑥ Rectifier Regulator
⑦ Accelerator position sensor
⑧ Oil pressure sensor
⑨ Starter motor
⑩ Diode (connect to the PTT relay)

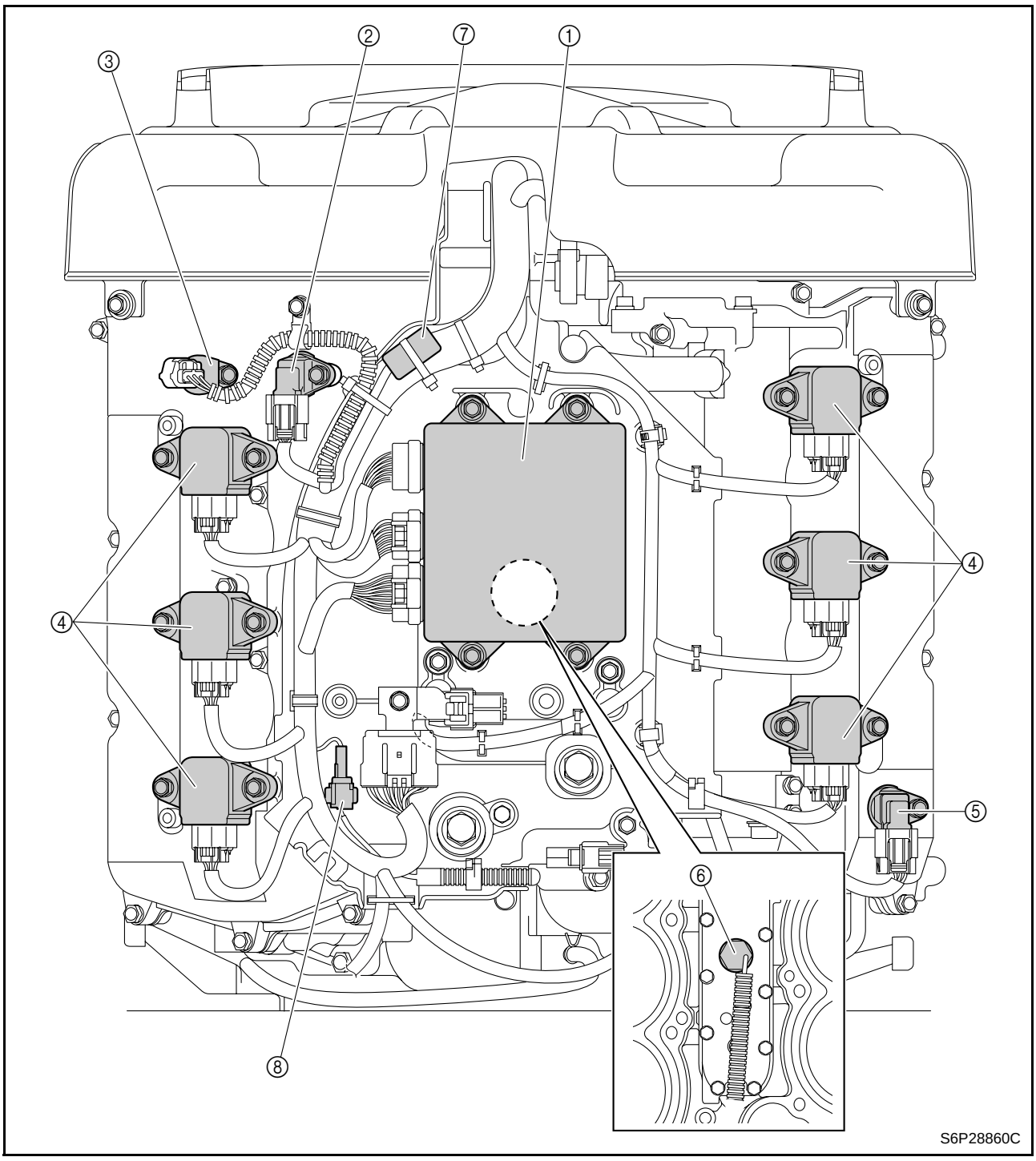
Fuse holder



S6P28025

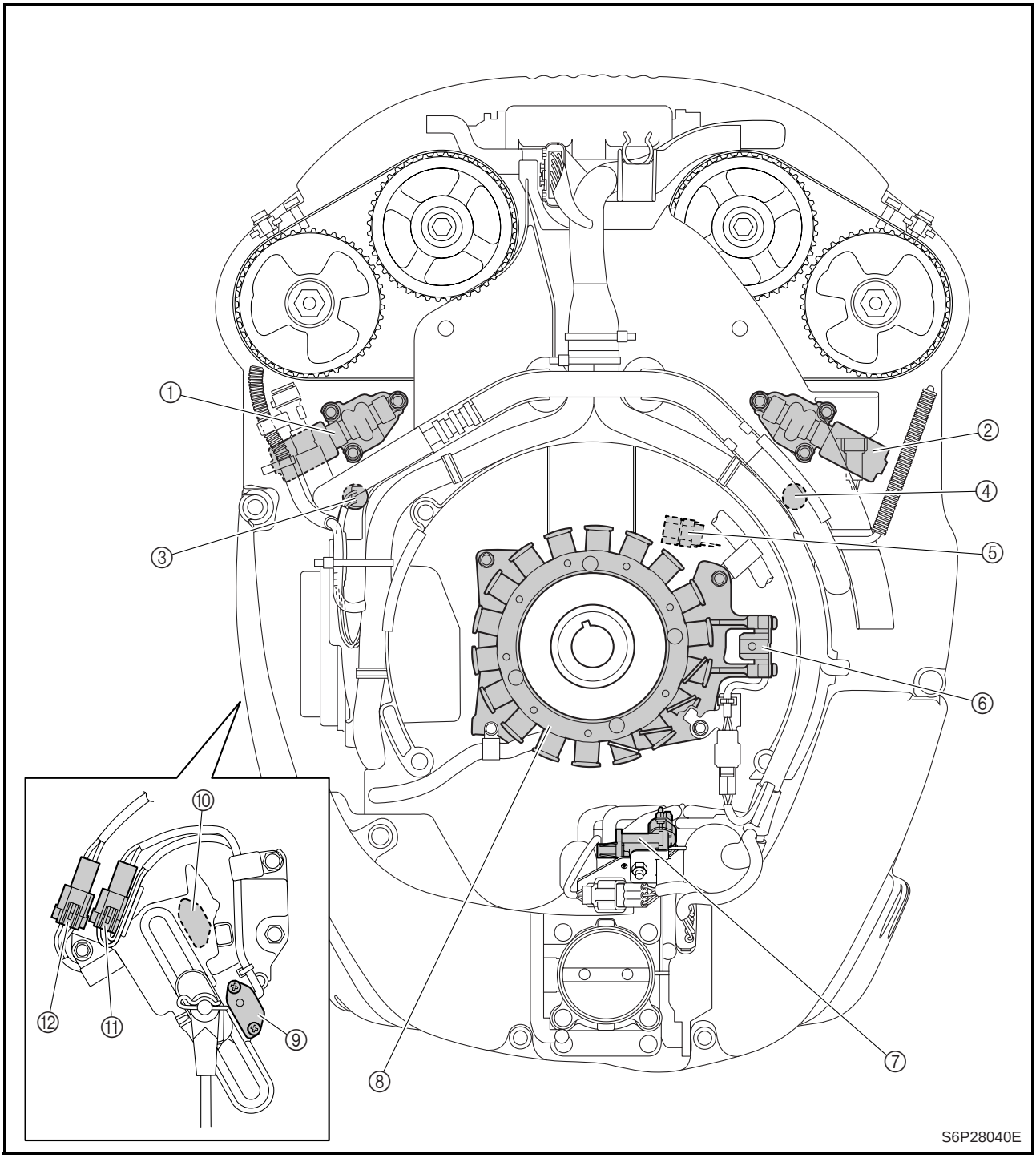
① Fuse (10 A) (electronic throttle valve, ECM)
② Fuse (30 A)
(ignition coil, fuel injector, variable camshaft timing, ECM)
③ Fuse (20 A) (engine start switch, PTT switch)
④ Fuse (30 A) (starter relay)
⑤ Fuse (5 A) (low-pressure fuel pump)
⑥ Fuse (15 A) (high-pressure fuel pump relay)
⑦ Fuse (80 A) (starting battery)
⑧ Fuse (80 A) (accessory battery)
⑨ High-pressure fuel pump relay
⑩ Electronic throttle valve relay
⑪ Main relay (ignition coil, fuel injector, variable camshaft timing, ECM, low-pressure fuel pump, high-pressure fuel pump)
⑫ Starter relay

Aft view



① ECM
② Cam position sensor (PORT EX)
③ Cam position sensor (PORT IN)
④ Ignition coil
⑤ Cam position sensor (STBD IN)
⑥ Knock sensor
⑦ Condenser assembly (connect to the cam position sensor (PORT EX))
⑧ Coupler (knock sensor) (white)

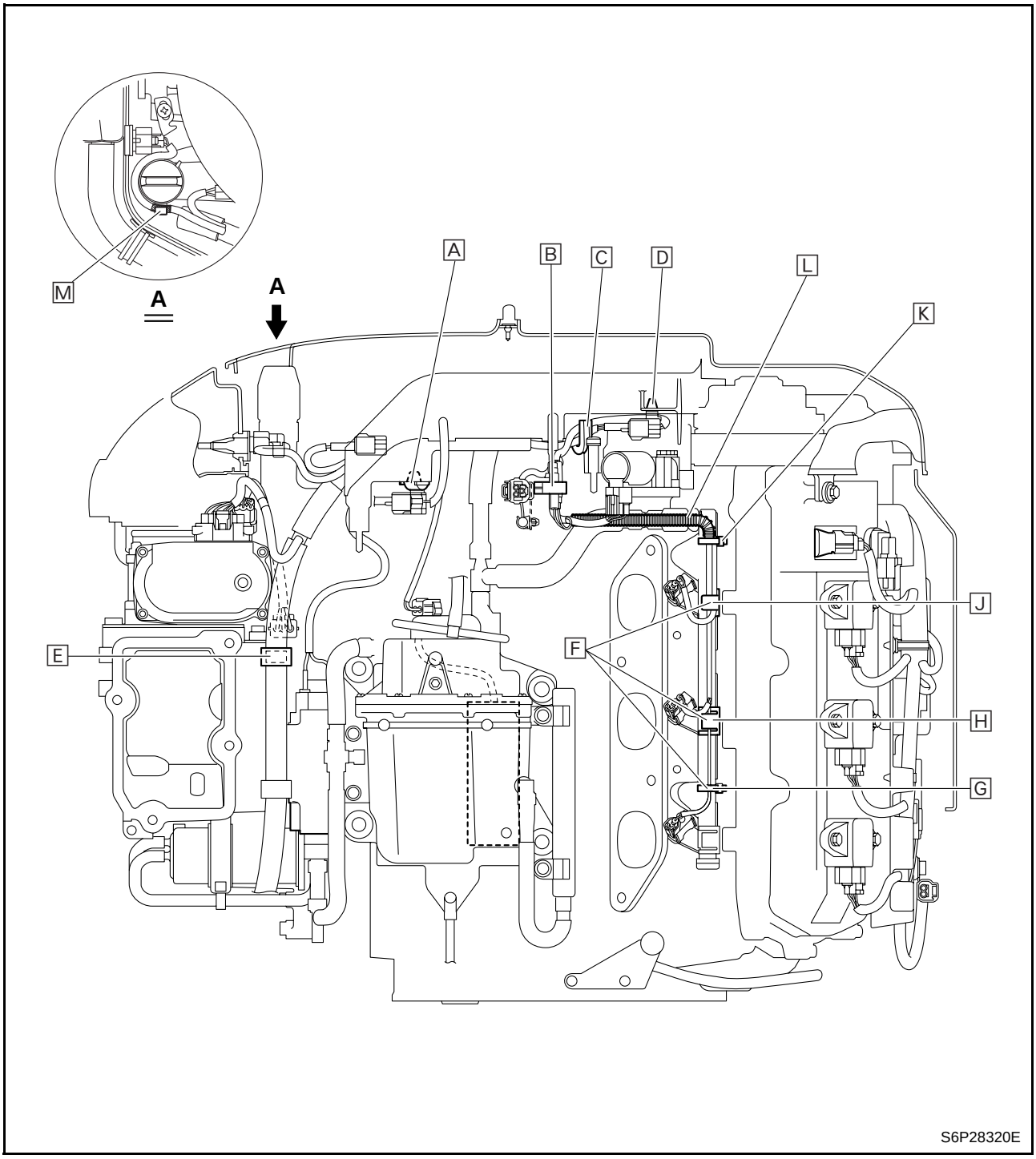
Top view



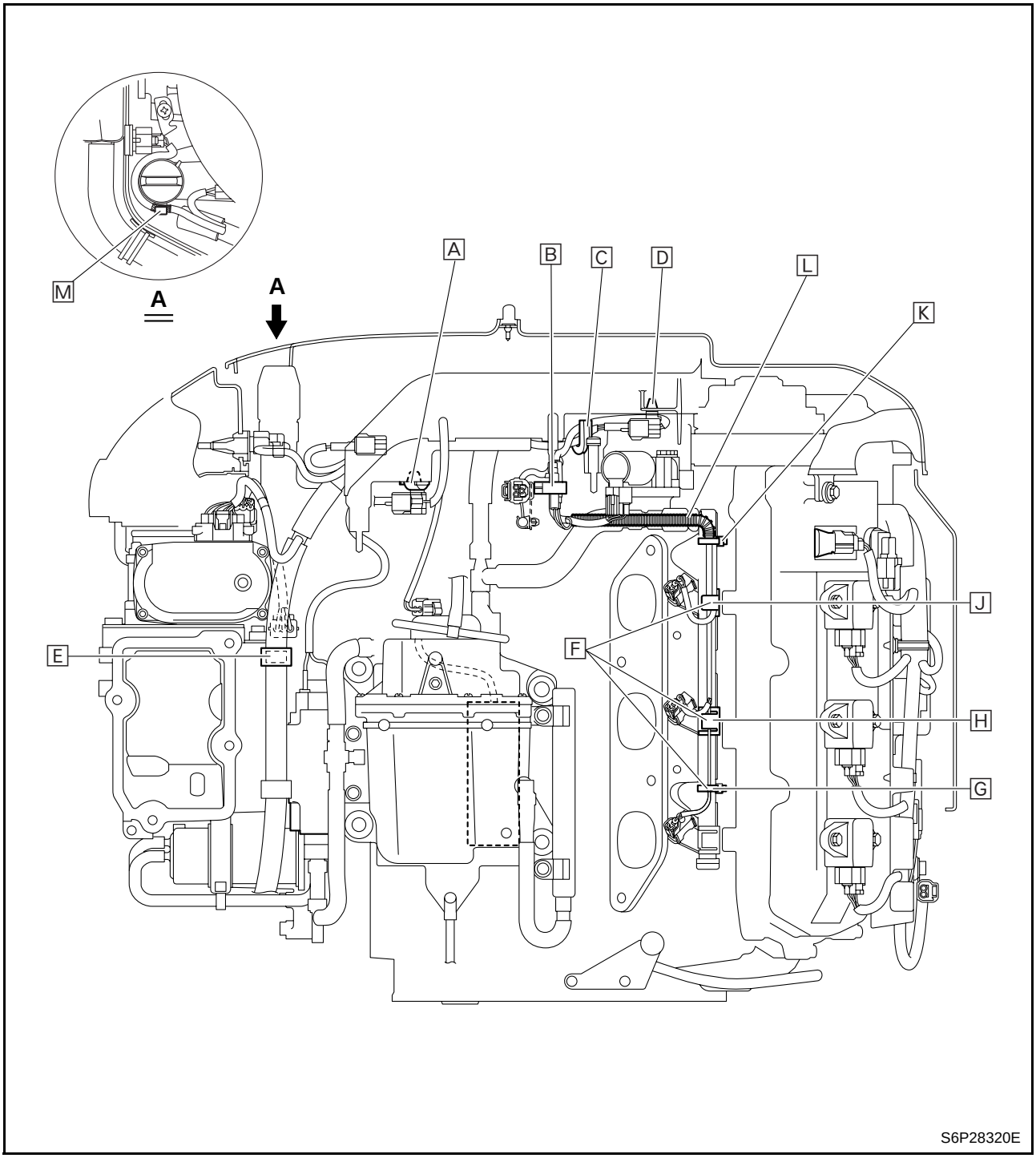
① Oil control valve (STBD)
② Oil control valve (PORT)
③ Thermoswitch (STBD)
④ Thermoswitch (PORT)
⑤ Engine temperature sensor
⑥ Crank position sensor
⑦ Vapor shut-off valve
⑧ Stator assembly
⑨ Neutral switch
⑩ Shift cut switch
⑪ Neutral switch coupler (blue)
⑫ Shift cut switch coupler (black)

Wiring harness routing

Port view

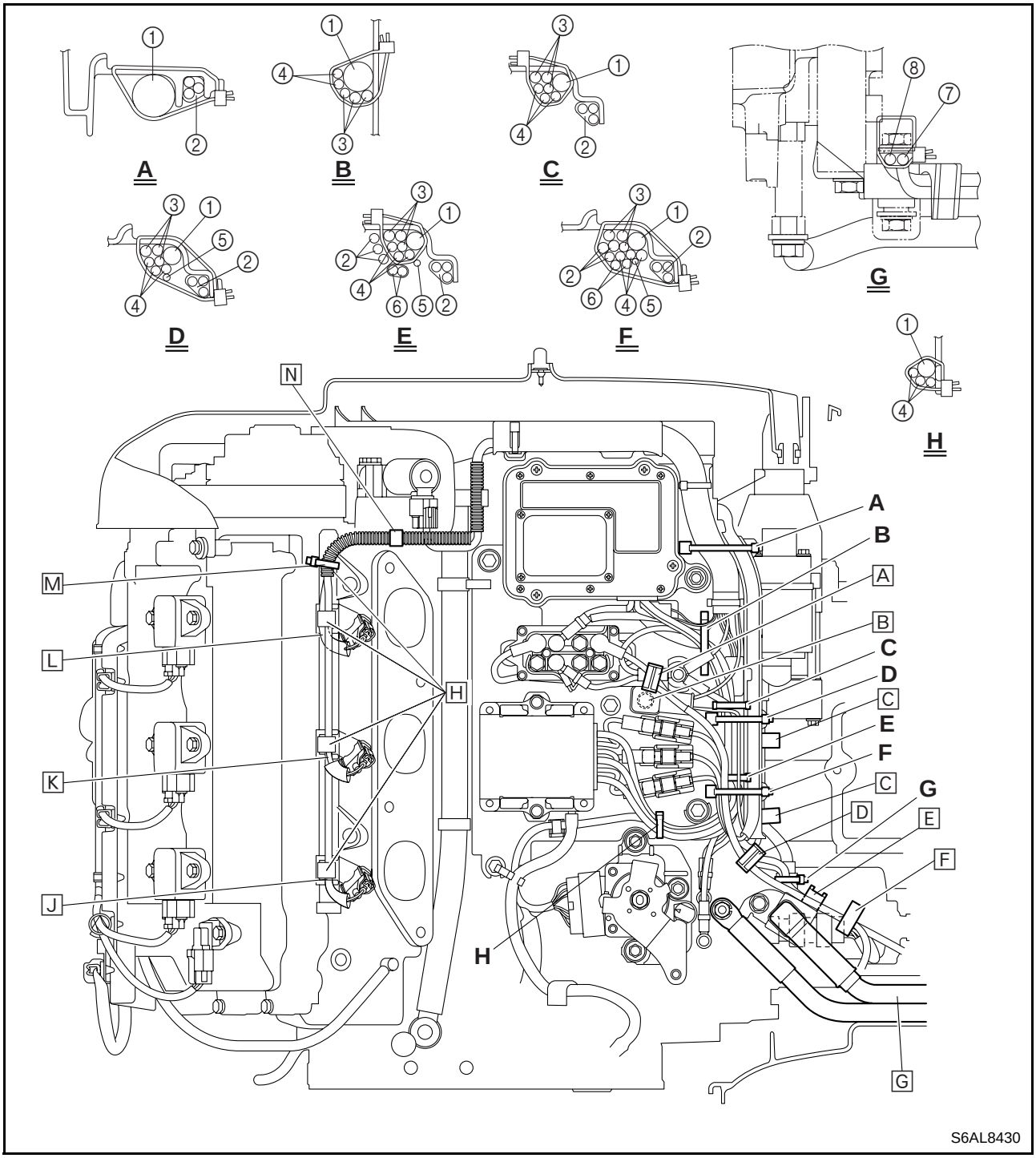


A Install the low-pressure fuel pump coupler onto the wiring harness guide.
B Fasten the thermoswitch connectors and wiring harness (oil control valve and fuel injectors) to the holder.
C Fasten the engine temperature sensor lead and thermoswitch lead on the hook of the wiring harness guide.
D Install the engine temperature sensor coupler onto the wiring harness guide.
E Fasten the wiring harness to the holder at the white tape.
F Fasten the fuel injector lead in the order of G, H, and J.
G Fasten the fuel injector lead (#6) using a plastic tie at the white tape.



H Fasten the fuel injector lead (#4) to the clip. It is not necessary to fasten the lead if its length is short.
J Fasten the fuel injector lead (#2), and then fasten the fuel injector lead (#4 and #6) to the clip.
K Fasten the fuel injector harness using a plastic tie.
L Fasten the fuel injector harness to the fuel rail cover after installing the cover.
M Fasten the intake air temperature sensor lead to the holder on the oil filler neck.

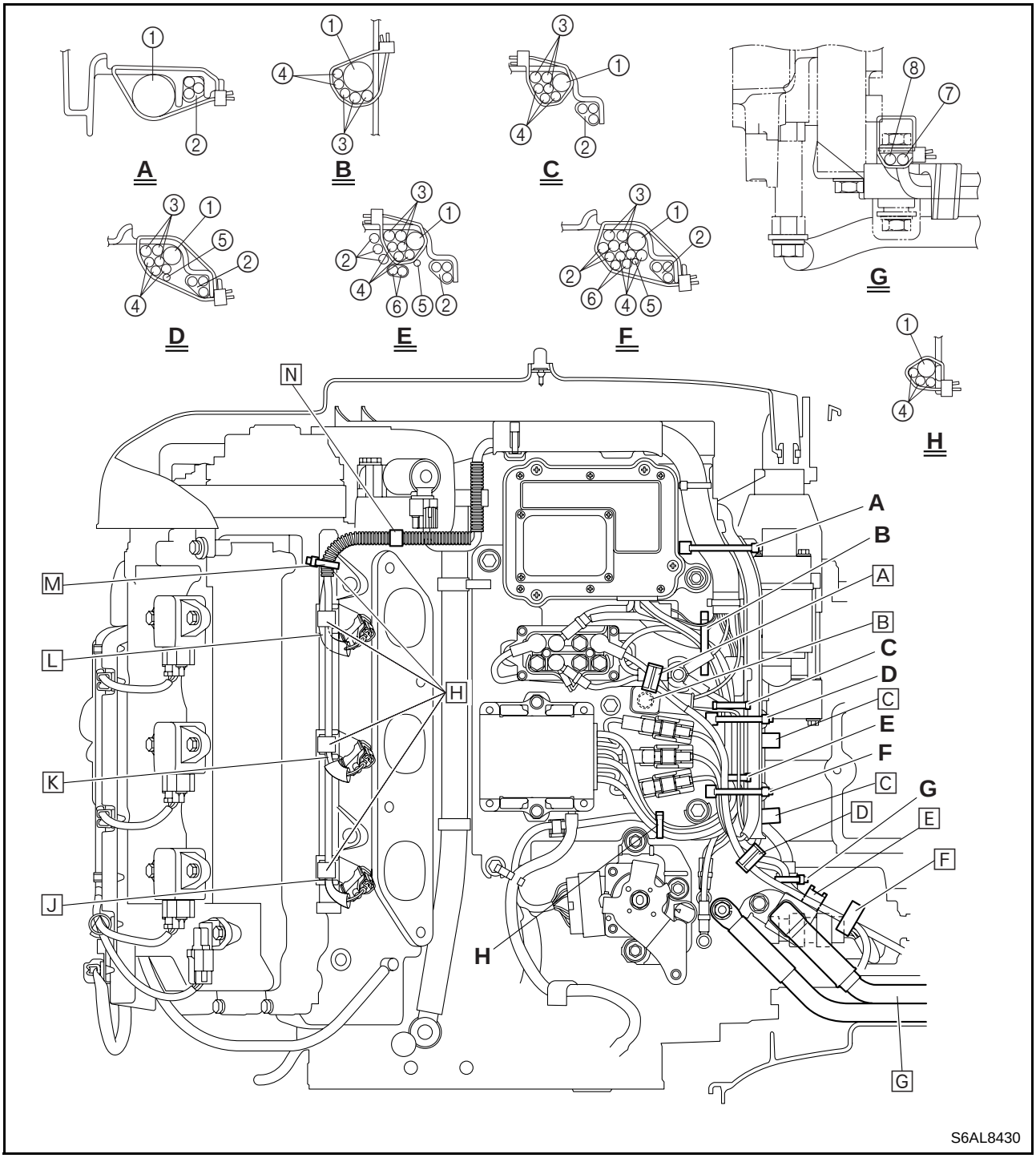
Starboard view



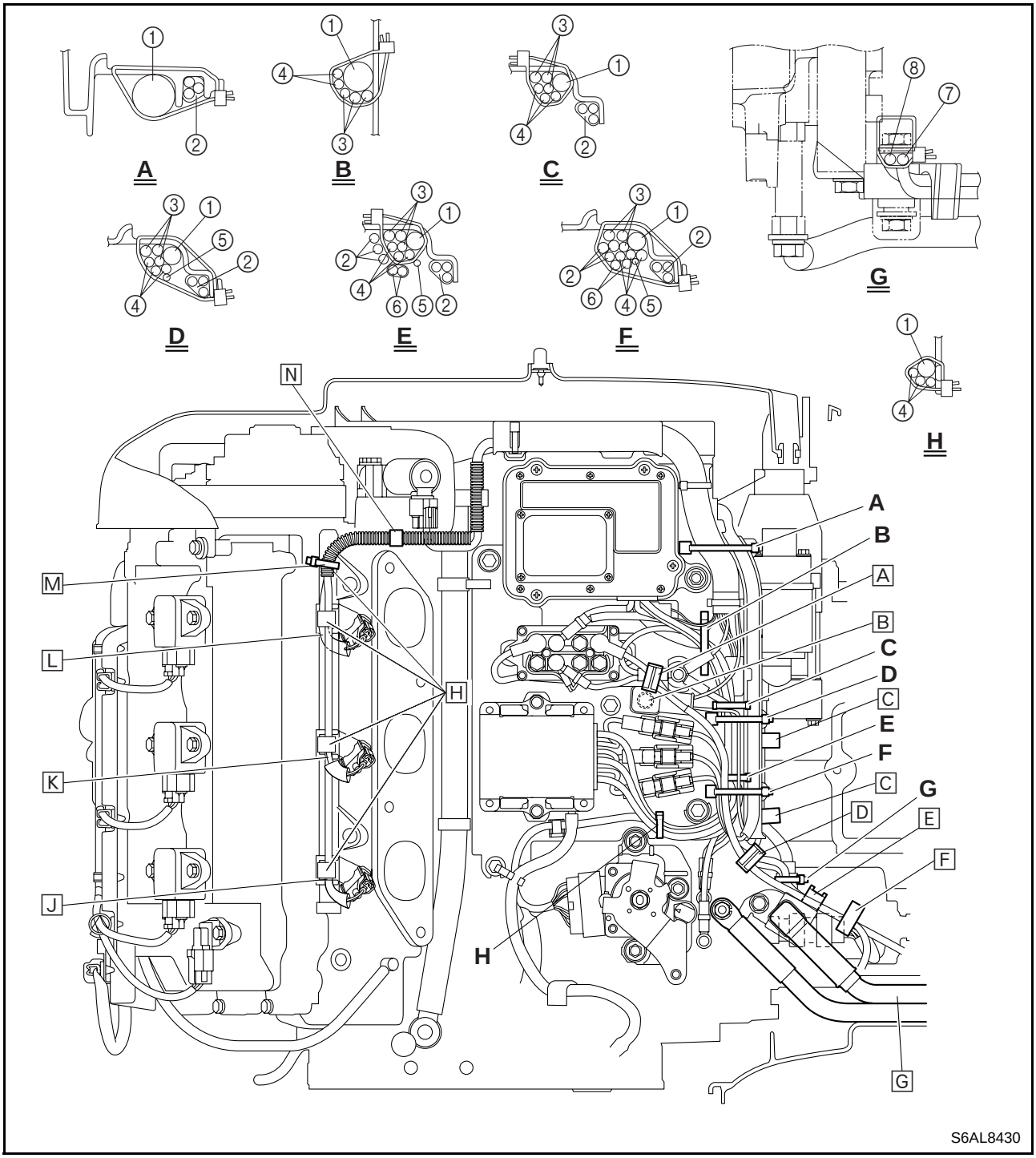
① Wiring harness (A–B–C–D–E–F–H)
② Stator coil lead (A–D–F)
③ Sub wiring harness (B–C–D–E–F)
④ Rectifier Regulator lead (B–C–D–E–F–H)
⑤ Starter motor lead (B–D–F–C–C)
⑥ PTT motor lead (A–F–D–E–F)
⑦ Oil pressure sensor lead and water detection switch lead (D–G–E–F)
⑧ Isolator lead (D–G–E–F)

NOTE:
The captions identifying the locations where the leads are routed, fastened, etc., are enclosed by parentheses. The captions are listed in random order.

8



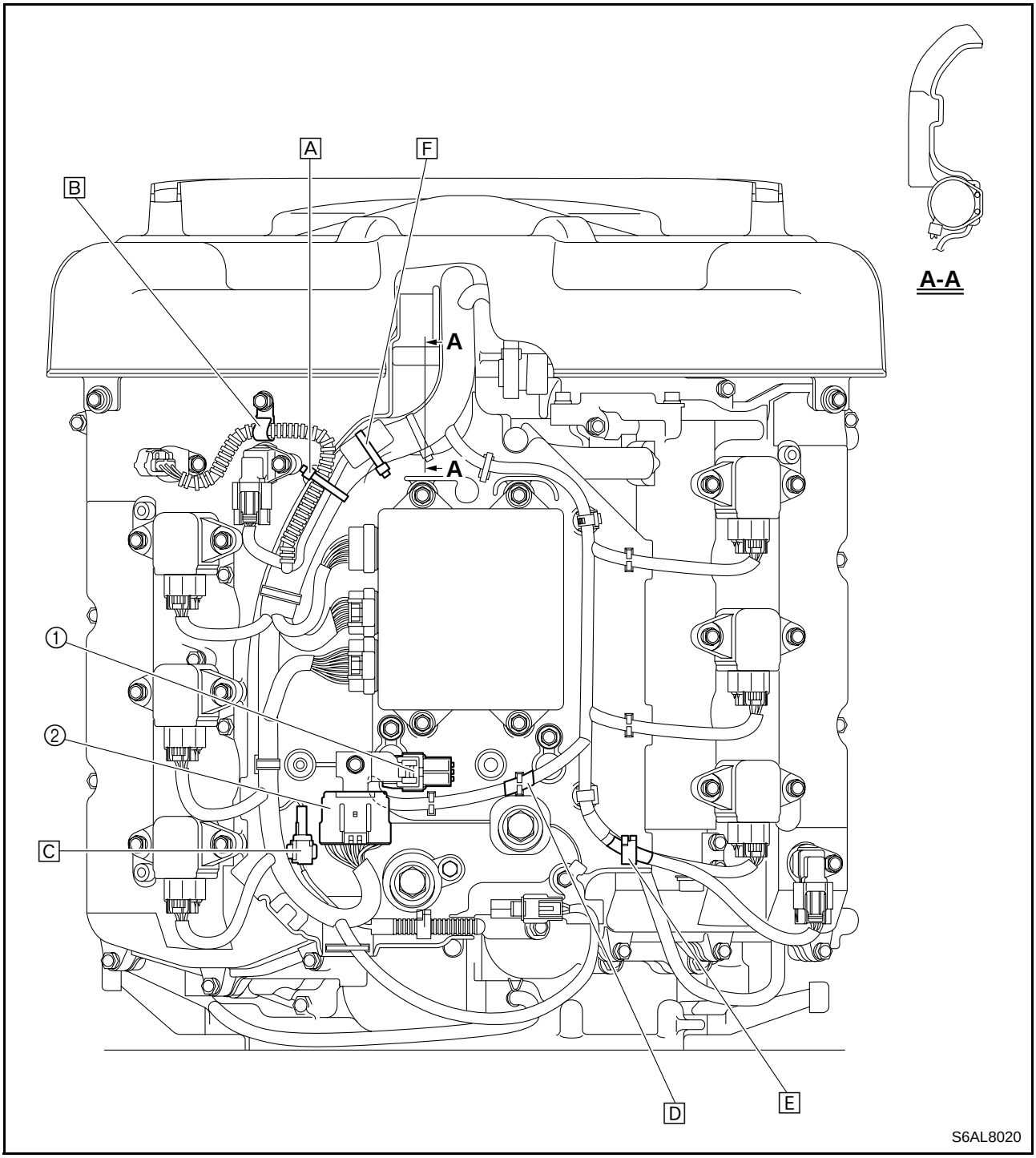
A Fasten the PTT motor lead and ground lead of the wiring harness to the holder.
B Install the starter motor lead and brown lead of the wiring harness with the bolt.
C Fasten the starter motor lead and sub wiring harness to the holders.
D Fasten the starter motor lead, oil pressure sensor lead, PTT motor lead sub wiring harness, and isolator lead to the holder.
E Route the oil pressure sensor lead, isolator lead, and PTT motor lead through the guide. Align the white tape on the oil pressure sensor lead with the guide of the positive battery terminal.
F Fasten the oil pressure sensor lead, water detection switch lead, isolator lead, and PTT motor lead to the holder.
G Route the battery cables along the bottom of the bottom cowling.



H Fasten the fuel injector lead in the order of J, K, L, and M.
J Fasten the fuel injector lead (#5) to the clip at the white tape.
K Fasten the fuel injector lead (#3) to the clip. It is not necessary to fasten the lead if its length is short.
L Fasten the fuel injector lead (#1), and then fasten the fuel injector lead (#3 and #5) to the clip.
M Fasten the fuel injector harness using a plastic tie.
N Fasten the fuel injector lead and quick connector to the holder.

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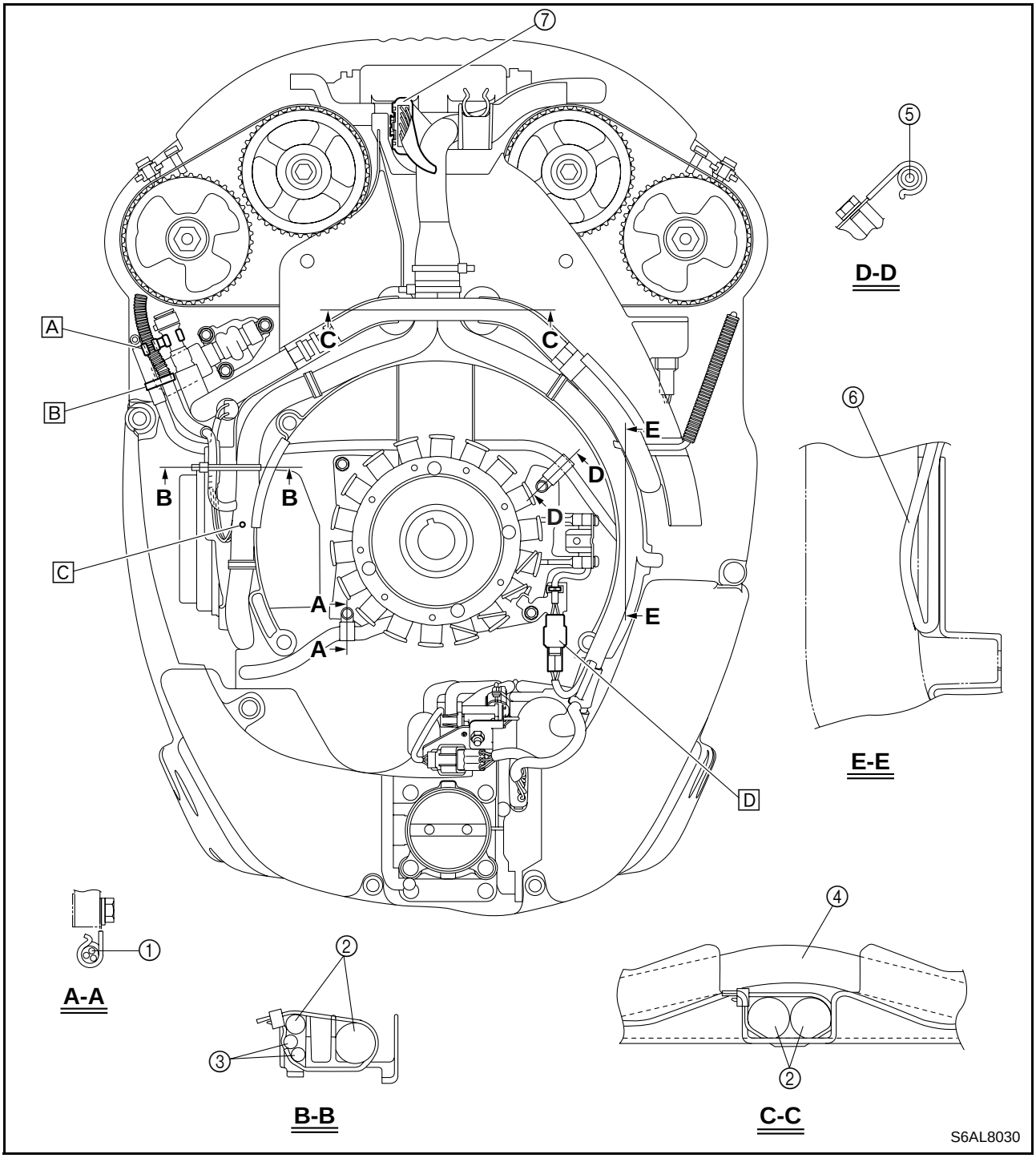
Aft view



① Cooling water pressure sensor coupler
② Joint connector

A Fasten the wiring harness and cam position sensor lead (PORT IN) using a plastic tie.
B Fasten the cam position sensor lead (PORT IN) to the holder.
C Install the clip of the knock sensor coupler to the hole of the ECM bracket.
D Fasten the cooling water pressure sensor lead to the holder at the white tape.
E Fasten the ignition coil lead (#5) and cam position sensor lead (STBD IN) to the holder at the white tape.
F Fasten the wiring harness and condenser assembly using a plastic tie.

Top view

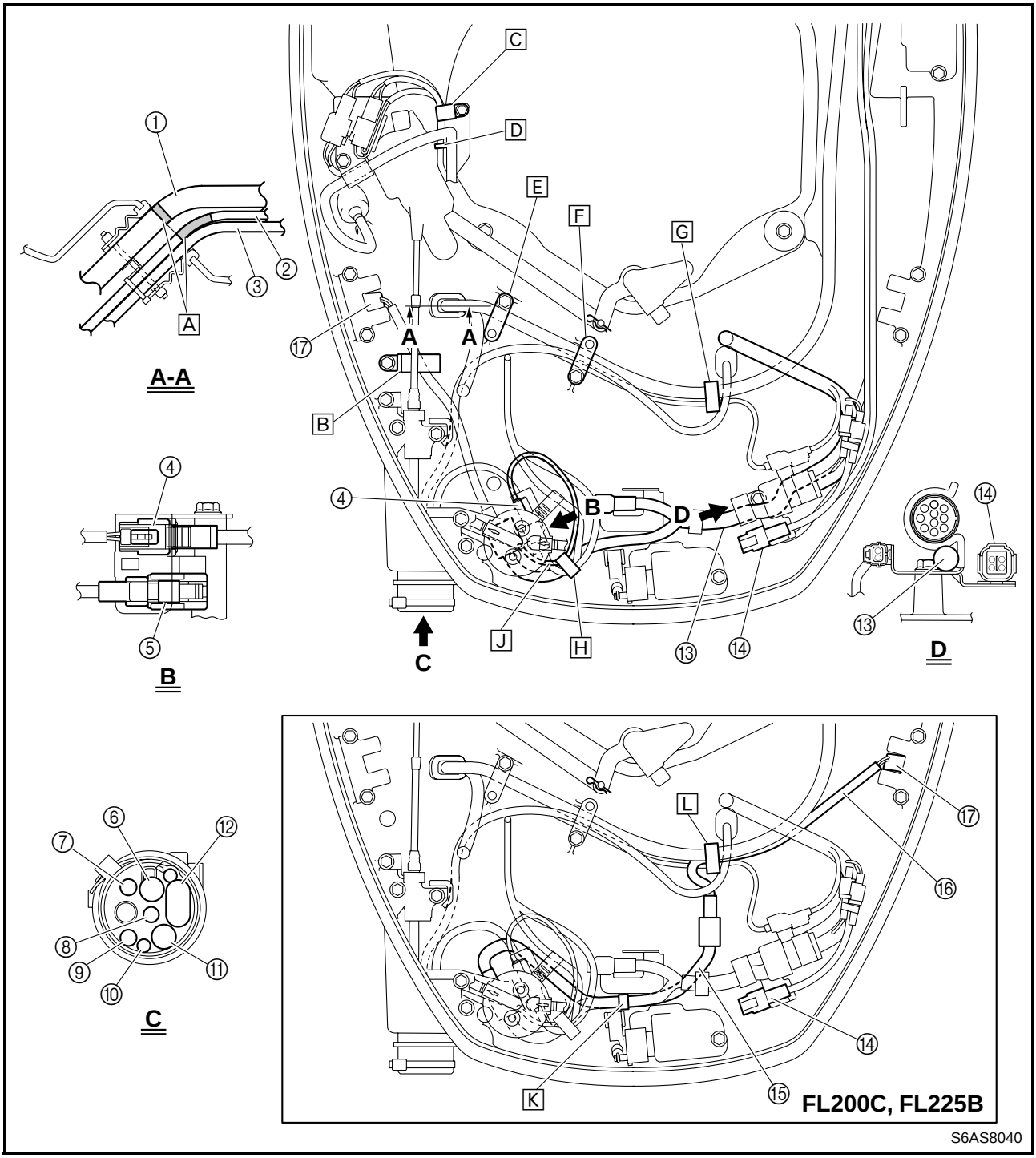


① Stator coil lead
② Wiring harness
③ Thermoswitch connector
④ High-pressure fuel hose
⑤ Vapor gas hose
⑥ Engine temperature sensor lead
⑦ Joint connector

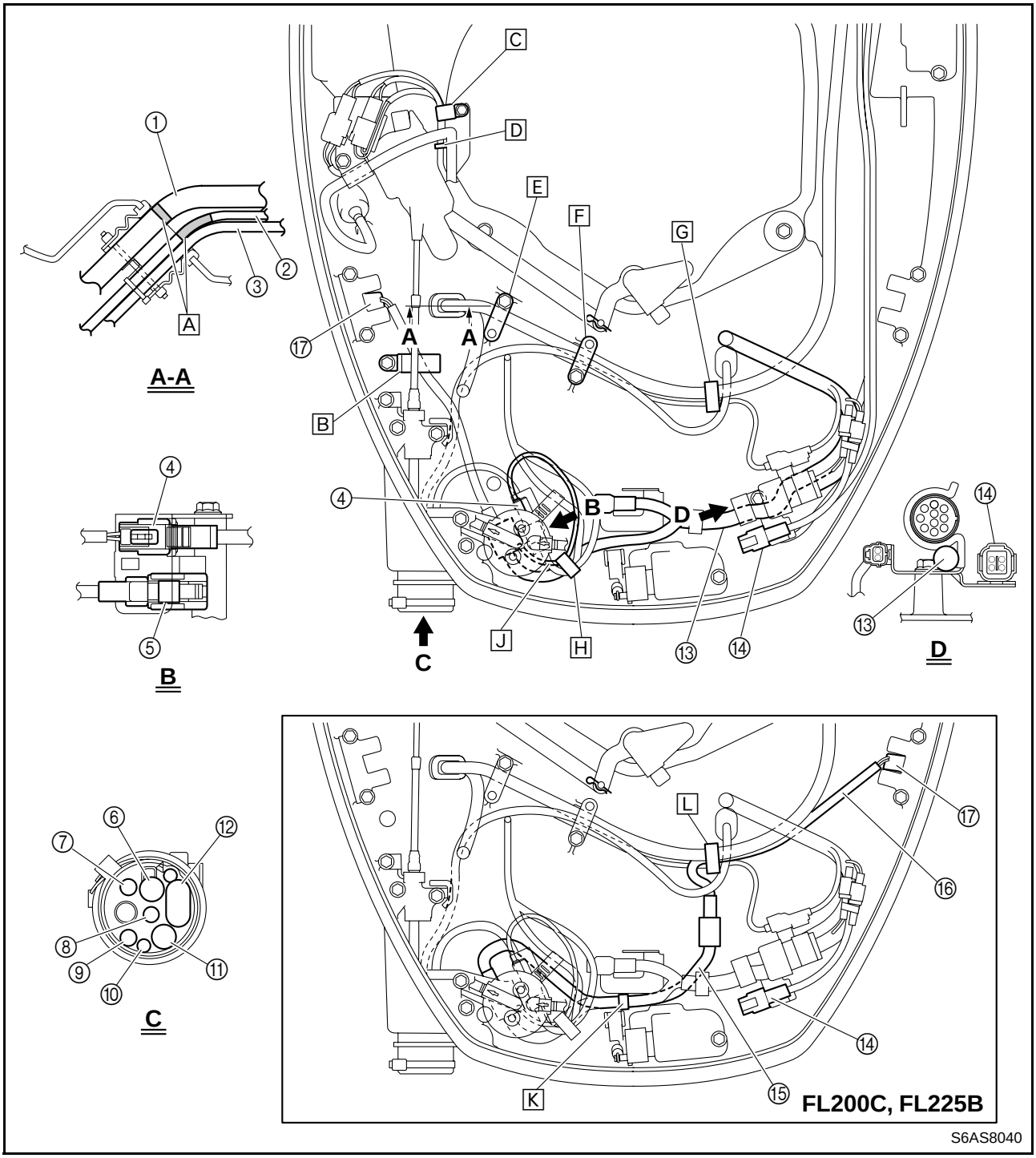
[A] Fasten the fuel injector lead and quick connector to the holder.
[B] Fasten the fuel injector lead and vapor gas hose to the holder.
[C] Face the white mark on the wiring harness upward.
[D] Install the crank position sensor coupler to the bracket.

8

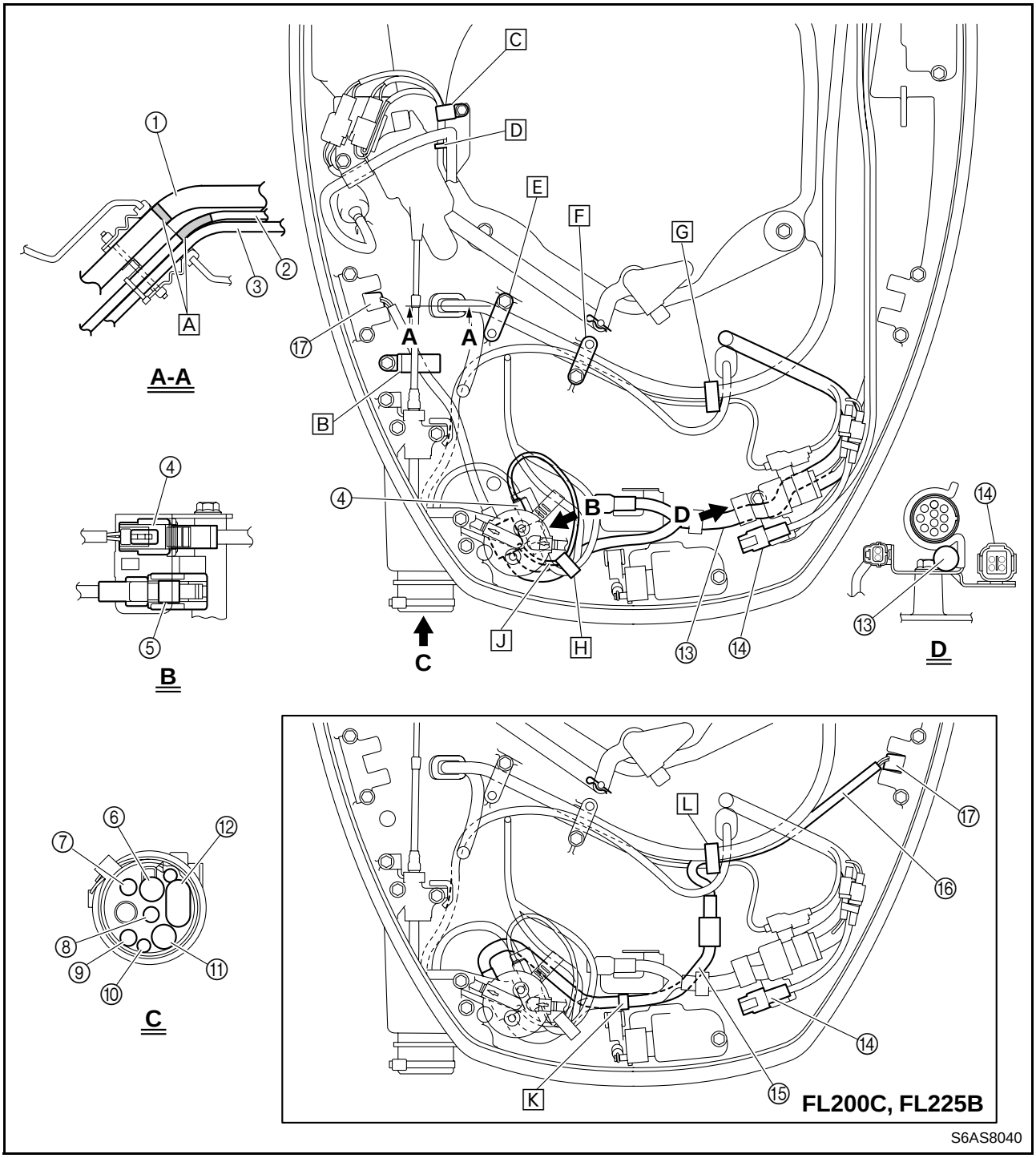
Bottom cowling



① Flushing hose
② PTT motor lead
③ Trim sensor lead
④ Water detection switch coupler (blue)
⑤ Isolator coupler (black)
⑥ 10-pin main harness
⑦ Throttle cable
⑧ Gauge harness
⑨ Shift cable
⑩ Speedometer hose
⑪ Fuel hose
⑫ Battery cable
⑬ Wiring harness
⑭ LAN communication coupler
⑮ PTT switch extension lead
⑯ PTT switch lead
⑰ PTT switch



A Make sure that the white paint mark on the flushing hose and the white tape on the PTT motor leads are positioned as shown.
B Fasten the PTT switch lead with the holder.
C Fasten the neutral switch lead and wiring harness with the holder.
D Fasten the neutral switch lead and wiring harness with the clamp.
E Fasten the flushing hose and trim sensor lead with the plate.
F Fasten the flushing hose, trim sensor lead, and speedometer hose with the plate.
G Fasten the flushing hose and trim sensor lead with the clamp.
H Fasten the PTT switch lead, isolator lead, and wire lead with the clamp.
J Route the water detection switch lead so that there is no excess slack between the fuel filter and the clamp.



K Fasten the PTT switch lead (wiring harness side) and PTT switch extension lead with the holder.
L Fasten the flushing hose, PTT switch lead and trim sender lead with the clamp.

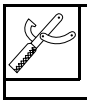
Ignition and ignition control system

Checking the ignition spark

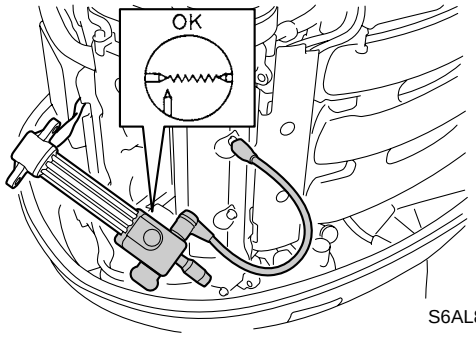
1. Remove the ECM cover.
2. Remove the ignition coils.

NOTE:
To prevent the engine from starting when cranking it, be sure to remove all of the ignition coils or disconnect all of the injector couplers.

3. Connect an ignition coil assembly to the special service tool.


Ignition tester: 90890-06754

4. Crank the engine and check the spark. If the spark is weak, check the ignition system.



S6AL8090

⚠ WARNING
- **Do not touch any of the connections of the special service tool.**
- **Be sure to install the special service tool to the ignition coil so that sparks do not leak out.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

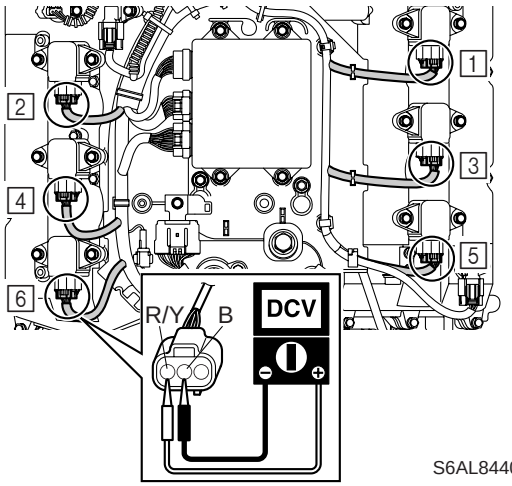
NOTE:
The ignition spark can also be checked using the “Stationary test” of the YDIS.

5. Install the ignition coils.
6. Install the ECM cover.

NOTE:
Connect the injector couplers.

Checking the ignition coil input voltage

1. Disconnect the ignition coil coupler.
2. Turn the engine start switch to “ON,” and then measure the input voltage at the ignition coil coupler (wiring harness end). Check the wiring harness if below specification.



S6AL8440


Ignition coil input voltage:
Red/yellow (R/Y) – Black (B)
12 V (battery voltage)

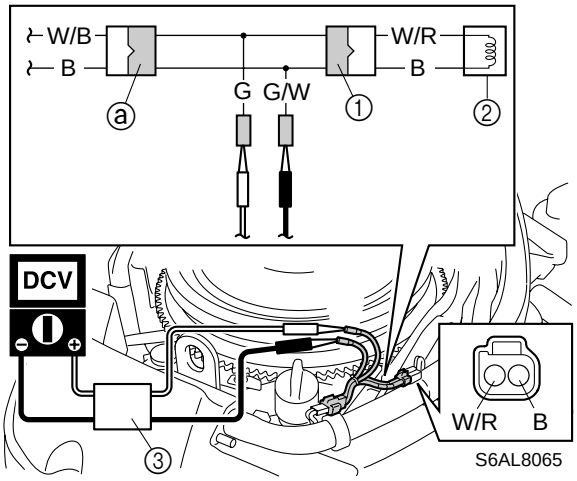
3. Turn the engine start switch to “OFF.”
4. Connect the ignition coil coupler.

Checking the crank position sensor

1. Remove the flywheel magnet cover.
2. Disconnect the crank position sensor coupler.

8

3. Connect the test harness (2 pins) ① to the crank position sensor ②, and then measure the crank position sensor output peak voltage.



CAUTION:

Check that the wiring harness does not interfere with the flywheel magnet.

NOTE:

- If measuring the sensor output peak voltage under the "cranking" and "unloaded" conditions, disconnect the coupler ⓐ.
- If measuring the sensor output peak voltage under the "cranking" and "loaded" conditions, remove the clip from the engine stop lanyard switch to prevent the engine from starting.
- Check the crank position sensor air gap and the condition of the projection on the flywheel magnet if below specification.

Test harness (2 pins) ①:
90890-06867
Peak voltage adapter B ③:
90890-03172

Crank position sensor output peak voltage:
White/red (W/R) – Black (B)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	3.0	2.7	14.5	17.8

4. Measure the crank position sensor resistance.

NOTE:

Disconnect the test harness coupler ⓐ but leave the harness connected to the crank position sensor.

Crank position sensor resistance (reference data):
White/red (W/R) – Black (B)
396–594 Ω

Checking the crank position sensor air gap

1. Remove the wiring harness guide bolts and lift up the wiring harness guide.

NOTE:

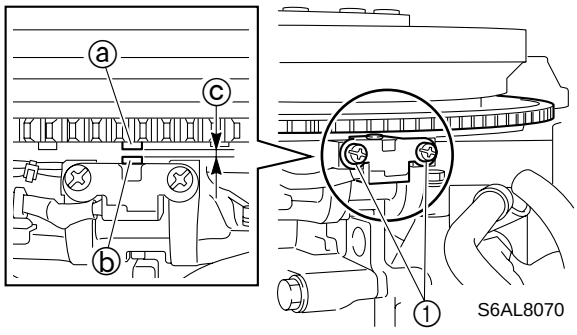
To completely remove the wiring harness guide when checking the air gap, see Chapter 4, "Reducing the fuel pressure" and Chapter 5, "Removing the wiring harness."

2. Turn the flywheel magnet clockwise to align the projection ⓐ on the flywheel magnet with the crank position sensor projection ⓑ.

3. Measure the crank position sensor air gap ⓒ. Adjust if out of specification.

Crank position sensor air gap ⓒ:
1.4–1.6 mm (0.055–0.063 in)

4. Loosen the crank position sensor screws ① and adjust the crank position sensor air gap.



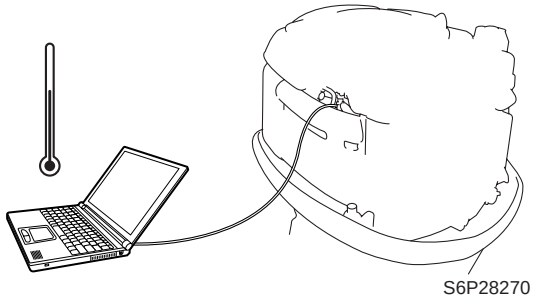
5. Tighten the crank position sensor screws ①, and then check the crank position sensor air gap. Adjust again if out of specification.

Crank position sensor screw ①:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

6. Install the wiring harness guide and the wiring harness guide bolts.

Checking the intake air temperature sensor

1. Measure the ambient temperature.
2. Connect a computer to the outboard motor and use the YDIS to display "Intake temperature."

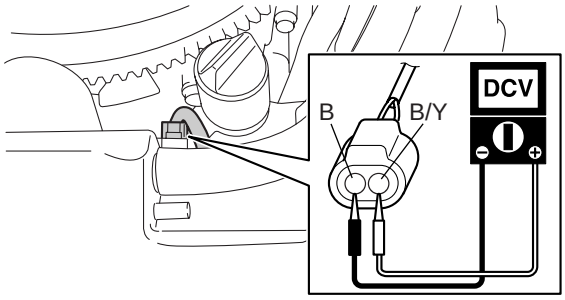

S6P28270

NOTE:
To connect and operate the YDIS, see Chapter 9, "YDIS" and the YDIS (Ver. 1.23a or later) Instruction Manual.

3. Check that the difference between the ambient temperature and the displayed intake air temperature is within ± 5 °C (± 9 °F).

NOTE:
- Check the intake air temperature sensor when the engine is cold.
- When checking the intake air temperature sensor, remove the top cowling and do not start the engine.

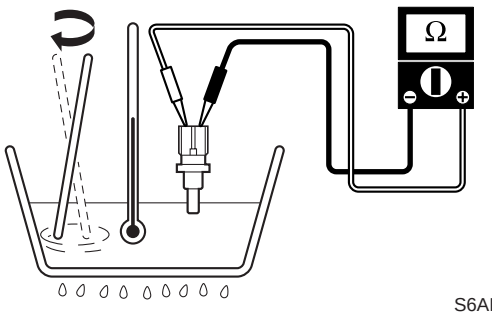
4. Disconnect the intake air temperature sensor coupler.
5. Turn the engine start switch to "ON," and then measure the input voltage at the intake air temperature sensor coupler (wiring harness end). Check the wiring harness if out of specification.



S6AL8450

Intake air temperature sensor input voltage (reference data):
Black/yellow (B/Y) – Black (B)
4.75–5.25 V

6. Turn the engine start switch to "OFF."
7. Remove the intake air temperature sensor.
8. Place the intake air temperature sensor in a container of water and slowly heat the water.



S6AL8460

9. Measure the intake air temperature sensor resistance. Replace if out of specification.

Intake air temperature sensor resistance:
at 20 °C (68 °F): 2.21–2.69 kΩ

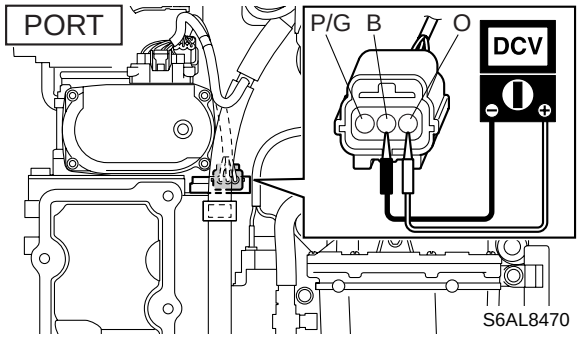
8

10. Install the intake air temperature sensor, and then connect the intake air temperature sensor coupler.

Checking the intake air pressure sensor

1. Disconnect the intake air pressure sensor coupler.

2. Turn the engine start switch to “ON,” and then measure the input voltage at the intake air pressure sensor coupler (wiring harness end). Check the wiring harness if out of specification.

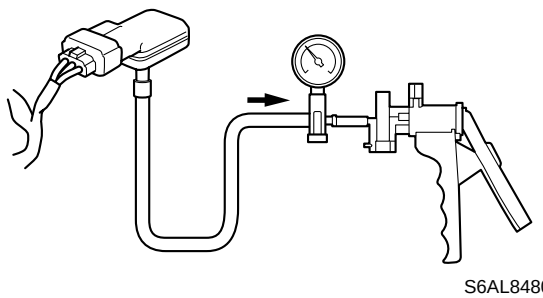


Intake air pressure sensor input voltage (reference data):
Orange (O) – Black (B)
4.75–5.25 V

3. Turn the engine start switch to “OFF.”

4. Remove the intake air pressure sensor, and then connect the coupler.

5. Connect the special service tool.



Vacuum/pressure pump gauge set:
90890-06756

6. Check the intake air pressure using the YDIS.

NOTE:
To connect and operate the YDIS, see Chapter 9, “YDIS” and the YDIS (Ver. 1.23a or later) Instruction Manual.

7. Apply negative pressure to the intake air pressure sensor slowly, and check that the displayed intake air pressure is varied.

NOTE:
When checking the intake air pressure sensor, do not start the engine.

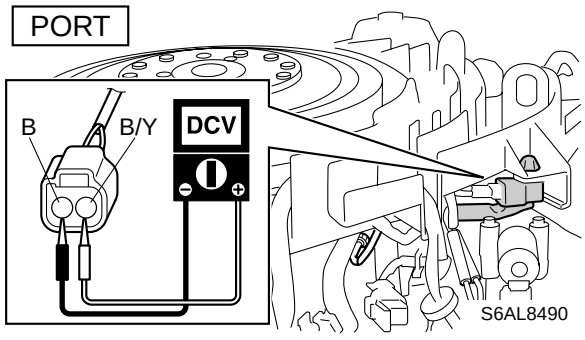
8. Disconnect the special service tool.

9. Install the intake air pressure sensor, and then connect the coupler.

Checking the engine temperature sensor

1. Disconnect the engine temperature sensor coupler.

2. Turn the engine start switch to “ON,” and then measure the input voltage at the engine temperature sensor coupler (wiring harness end). Check the wiring harness if out of specification.

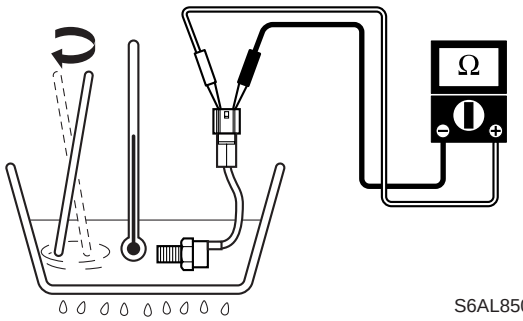


Engine temperature sensor coupler input voltage (reference data):
Black/yellow (B/Y) – Black (B)
4.75–5.25 V

3. Turn the engine start switch to “OFF.”

4. Remove the engine temperature sensor.

5. Place the engine temperature sensor in a container of water and slowly heat the water.



6. Measure the engine temperature sensor resistance. Replace if out of specification.

Engine temperature sensor resistance:
Black/yellow (B/Y) – Black/yellow (B/Y)
at 20 °C (68 °F): 54.2–69.0 kΩ
at 100 °C (212 °F): 3.12–3.48 kΩ

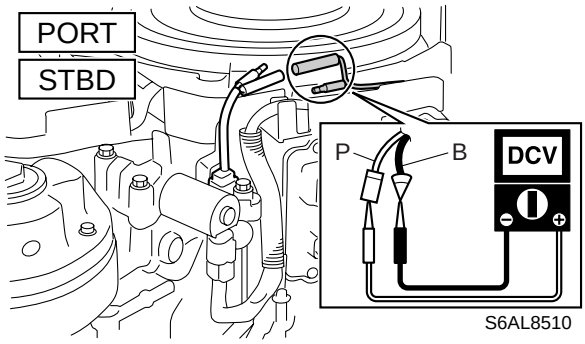
7. Install the engine temperature sensor, and then connect the engine temperature sensor coupler.

Checking the thermoswitch

1. Disconnect the thermoswitch connectors.

NOTE:
There are 2 thermoswitches: one on the port side of the power unit and one on the starboard side.

2. Turn the engine start switch to “ON,” and then measure the input voltage at the thermoswitch connectors (wiring harness end). Check the wiring harness if below specification.

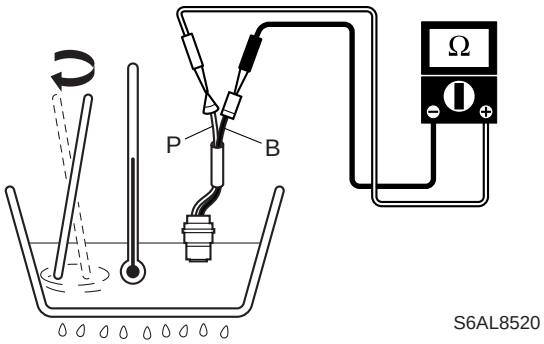


Thermoswitch input voltage:
Pink (P) – Black (B)
12 V (battery voltage)

3. Turn the engine start switch to “OFF.”

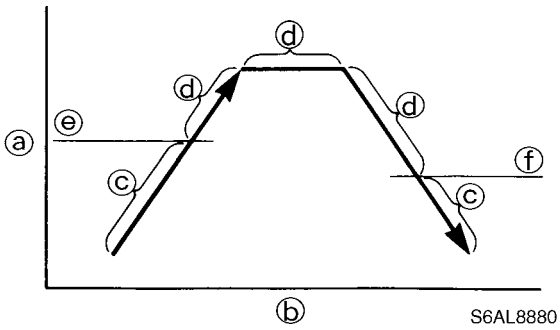
4. Remove the thermoswitches.

5. Place the thermoswitches in a container of water and slowly heat the water.



8

6. Check the switch for continuity at the specified temperatures. Replace if out of specification.



ⓐ Temperature
ⓑ Time
ⓒ No continuity
ⓓ Continuity

Thermoswitch continuity temperature:
Pink (P) – Black (B)
ⓔ: 84–90 °C (183–194 °F)
ⓕ: 68–82 °C (154–180 °F)

7. Install the thermoswitches, and then connect the thermoswitch connectors.

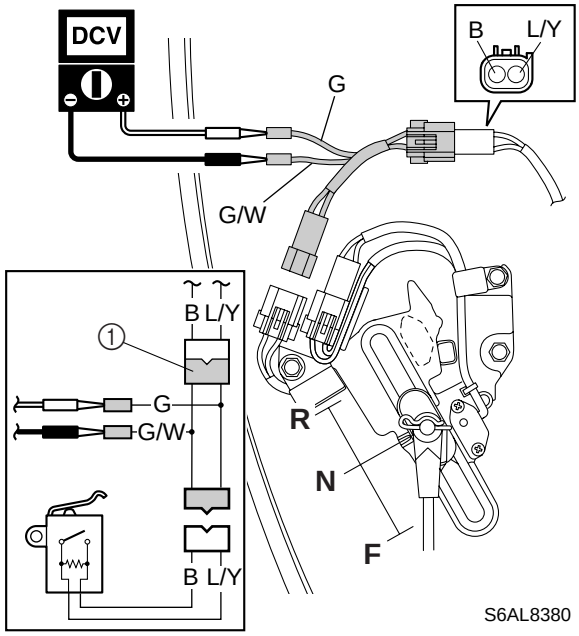
Checking the shift cut switch

1. Disconnect the shift cut switch coupler (black).

2. Connect the test harness (2 pins) ① to the shift cut switch coupler (wire harness end).

Test harness (2 pins) ①:
90890-06867

3. Turn the engine start switch to “ON,” and then measure the input voltage at the shift cut switch coupler (wiring harness end). Check the wiring harness if out of specification.

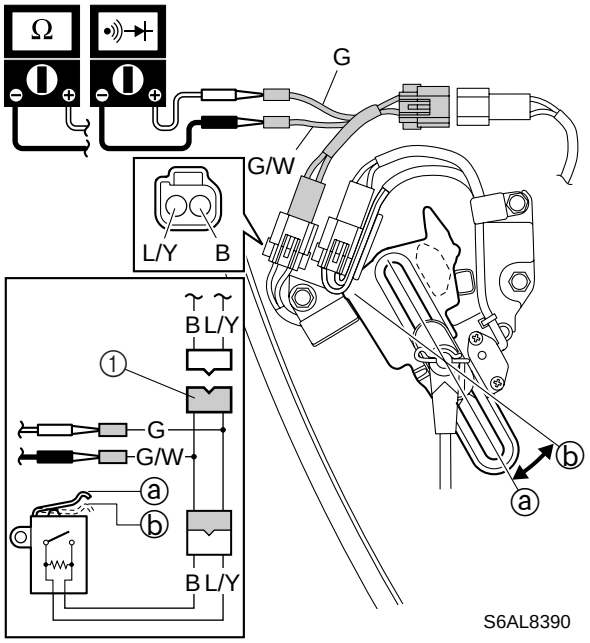


Shift cut switch input voltage (reference data):
Blue/yellow (L/Y) – Black (B)
4.75–5.25 V

4. Turn the engine start switch to “OFF.”

5. Disconnect the test harness (2 pins) ① from the shift cut switch coupler (wiring harness end) and connect it to the shift cut switch coupler (shift cut switch end).

6. To check the shift cut switch, measure the shift cut switch resistance at position ⓐ. Replace if out of specification.



Shift cut switch resistance:
4.465–4.935 kΩ (at position ⓐ)

7. Check the shift cut switch for continuity at position ⓑ. Replace if there is no continuity.

NOTE:
If the shift cut switch is installed, check the continuity when the shift bracket is at position ⓑ.

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free ⓐ		
Push ⓑ	○	○

8. Disconnect the test harness (2 pins) ① from the shift cut switch coupler (black), and then connect the shift cut switch coupler (black).

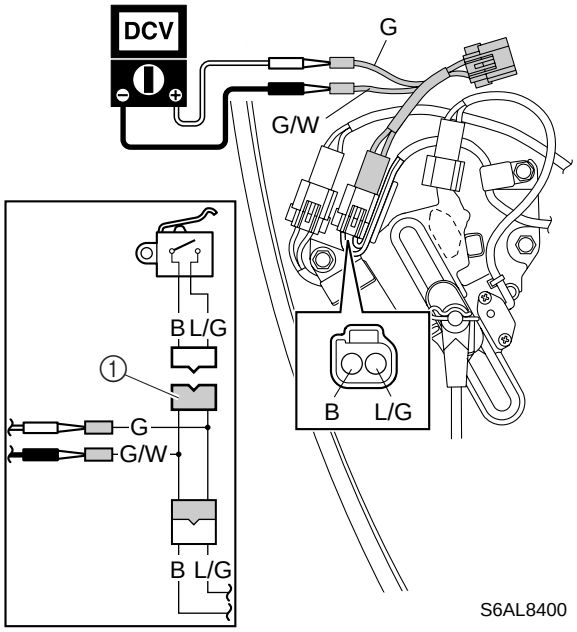
Checking the neutral switch

1. Disconnect the neutral switch coupler (blue).

2. Connect the test harness (2 pins) ① to the neutral switch coupler (wiring harness end).

Test harness (2 pins) ①:
90890-06867

3. Turn the engine start switch to "ON," and then measure the input voltage at the neutral switch coupler (wiring harness end). Check the wiring harness if out of specification.



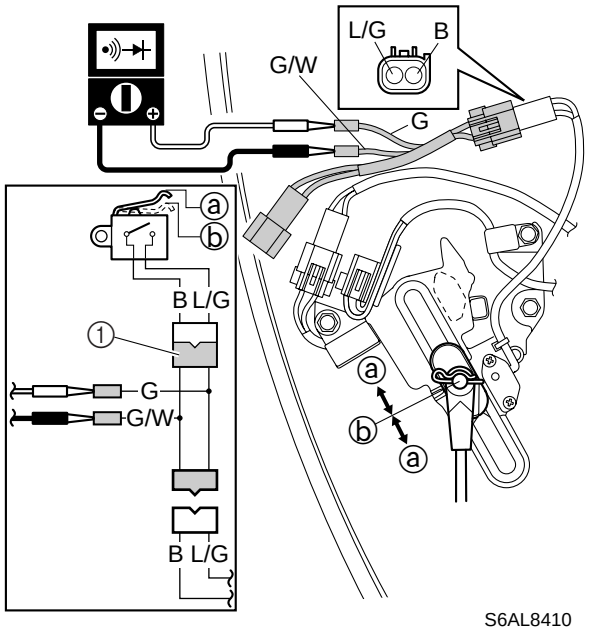
Neutral switch input voltage
(reference data):
Blue/green (L/G) – Black (B)
4.75–5.25 V

8

4. Turn the engine start switch to “OFF.”

5. Disconnect the test harness (2 pins) ① from the neutral switch coupler (wiring harness end) and connect it to the neutral switch coupler (neutral switch end).

6. Check the neutral switch for continuity. Replace if there is no continuity at position ⓑ.



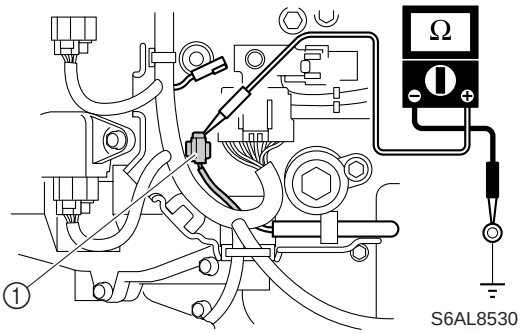
S6AL8410

Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free ⓐ		
Push ⓑ	○	○

7. Disconnect the test harness (2 pins) ① from the neutral switch coupler (blue), and then connect the neutral switch coupler (blue).

Checking the knock sensor

1. Disconnect the knock sensor coupler ① and connect the tester leads to the sensor coupler and ground.



S6AL8530

2. Measure the knock sensor resistance. Check the installation (ground state) of the knock sensor if out of specification.

NOTE:
To check the installation of the knock sensor, the cylinder head must be removed.

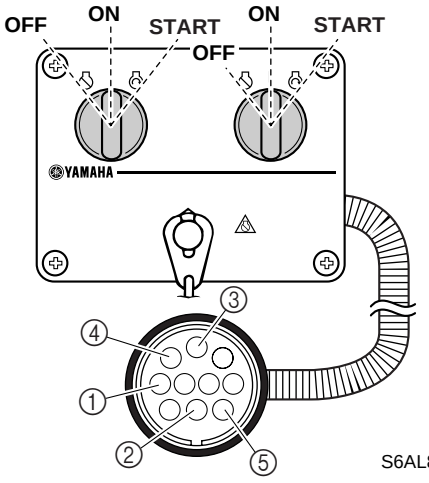
Knock sensor resistance:
504–616 kΩ

3. Disconnect the tester leads from the sensor coupler and ground and connect the knock sensor coupler ①.

Checking the engine start switch

1. Disconnect the 10-pin main harness coupler.

2. Check the engine start switch for continuity at the 10-pin main harness coupler (engine start switch end). Check the wiring harness or replace the engine start switch if there is no continuity.



S6AL8890

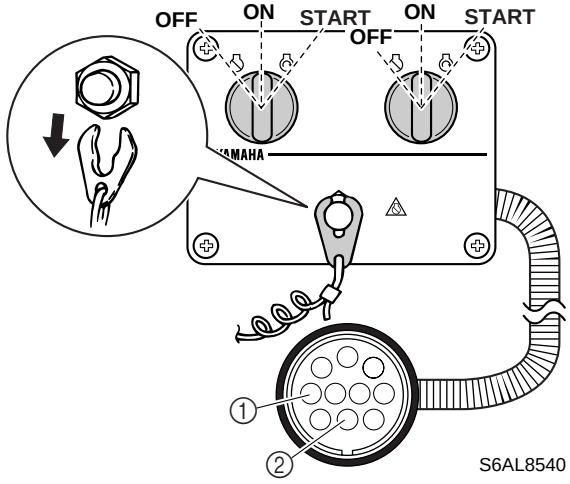
Switch position	Lead color				
	White (W) ①	Black (B) ②	Red (R) ③	Yellow (Y) ④	Brown (Br) ⑤
OFF	○	○			
ON			○	○	
START			○	○	○

3. Connect the 10-pin main harness coupler.

Checking the engine stop lanyard switch

1. Disconnect the 10-pin main harness coupler.

2. Turn the engine start switch to “ON,” and then check the engine stop lanyard switch for continuity at the 10-pin main harness coupler (engine stop lanyard switch end). Check the wiring harness or replace the engine stop lanyard switch if out of specification.



S6AL8540

Switch position	Lead color	
	White (W) ①	Black (B) ②
Clip removed	○	○
Clip installed		

3. Turn the engine start switch to “OFF.”

4. Connect the 10-pin main harness coupler.

ECM and electronic throttle valve control system

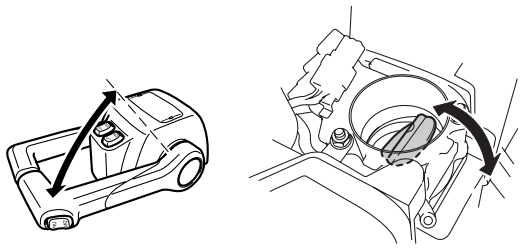
Checking the throttle valve operation

1. Remove the flywheel magnet cover and intake silencer.

NOTE:
See the exploded diagram (4-9).

2. Push the throttle valve directly and check that the valve moves smoothly when the engine start switch is turned to “OFF.”

3. Turn the engine start switch to “ON,” and then check that the throttle valve operates smoothly when the remote control lever is shifted from the fully closed position to the fully open position.


S6P24130

4. Turn the engine start switch to “OFF.”

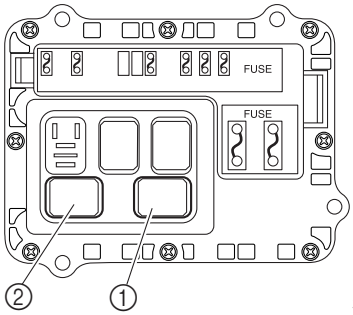
5. Install the intake silencer and flywheel magnet cover.

NOTE:
To install the intake silencer, see Chapter 4, “Installing the intake silencer.”

8

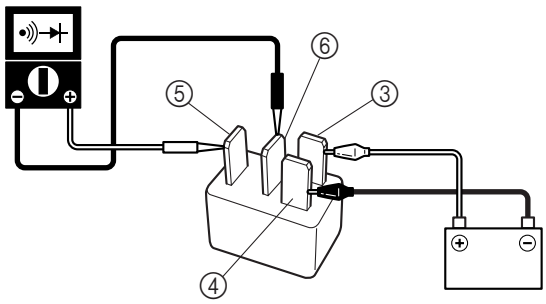
Checking the main relay and electronic throttle valve relay

1. Remove the main relay ① and electronic throttle valve relay ②.



S6P28150

2. Connect the positive battery lead to the relay terminal ③, and the negative battery lead to the relay terminal ④ as shown, and then check for continuity between terminals ⑤ and ⑥. Replace the relay if there is no continuity.



S6AL8140

CAUTION:

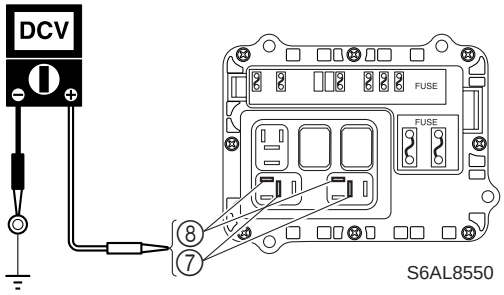
Do not reverse the battery leads.

Battery lead	Relay terminal No.	
	⑤	⑥
Connect	○	○
Disconnect		

3. Measure the input voltage between the terminals ⑦ and ground, and the terminals ⑧ and ground as shown.

NOTE:

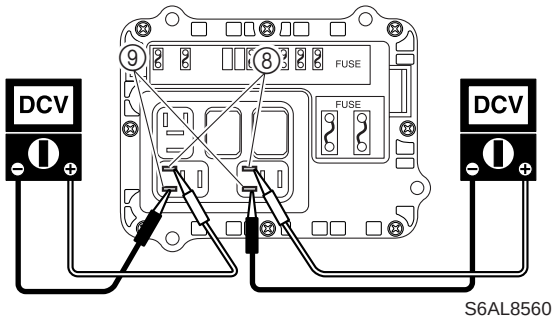
Measure the voltage with the battery connected and the engine start switch turned to "OFF."



S6AL8550

Terminal ⑦ – Ground:
Terminal ⑧ – Ground:
12 V (battery voltage)

4. Turn the engine start switch to "ON," and then measure the input voltage between terminals ⑧ and ⑨ as shown.



S6AL8560

Terminal ⑧ – Terminal ⑨:
12 V (battery voltage)

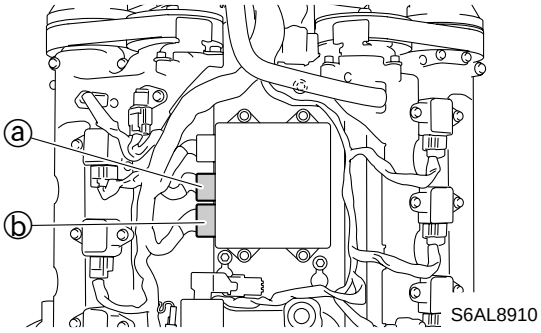
5. Turn the engine start switch to "OFF."

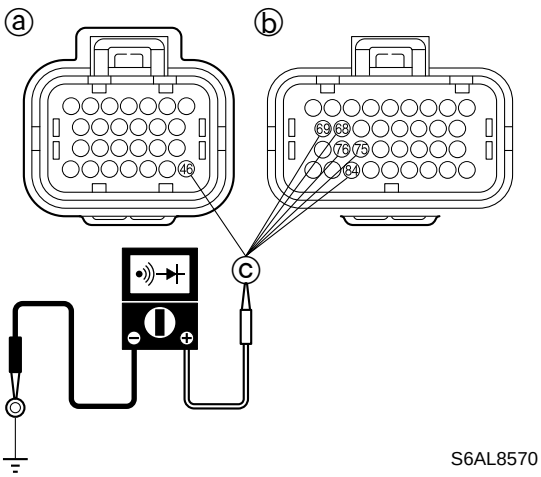
6. Install the main relay and electronic throttle valve relay, and then install all parts removed during disassembly.

Checking the ECM circuit

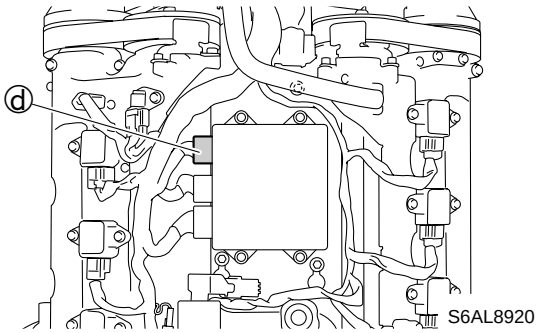
1. Disconnect the ECM couplers ⓐ and ⓑ.

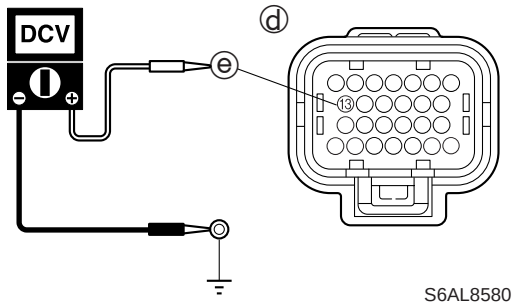
2. Check for continuity between the ECM coupler terminals ⓒ (46, 68, 69, 75, 76, and 84, wiring harness end) and ground. Check the wiring harness and ground if there is no continuity.





3. Connect the ECM couplers ⓐ and ⓑ.
4. Disconnect the ECM coupler ⓓ.
5. Turn the engine start switch to “ON,” and then measure the input voltage at ECM coupler terminal ⓔ (13, wiring harness end) and ground. Check the fuse, wiring harness, and engine start switch if below specification.





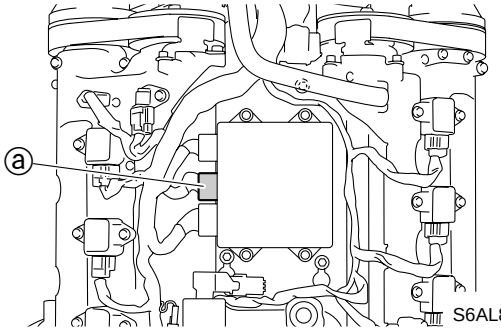
	Terminal ⓔ (Y) ⑬ – Ground: 12 V (battery voltage)

6. Turn the engine start switch to “OFF.”
7. Connect the ECM coupler ⓓ.

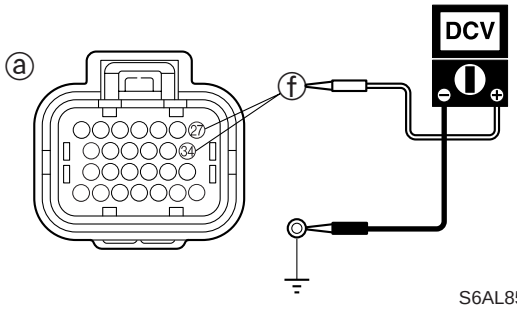
8

8. Disconnect the ECM coupler ⓐ.

9. Turn the engine start switch to “ON,” and then measure the input voltage at ECM coupler terminals ⓕ (27 and 34, wiring harness end) and ground. Check the fuse, relay, and wiring harness if below specification.



S6AL8900



S6AL8590

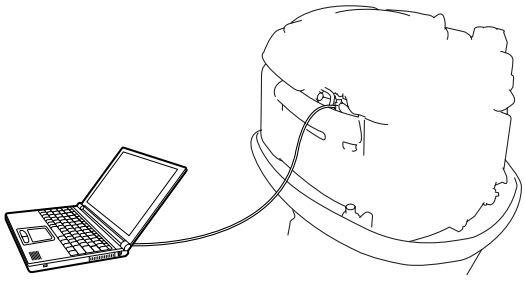
Terminal ⓕ (R/Y):
⑳ – Ground
㉞ – Ground
12 V (battery voltage)

10. Turn the engine start switch to “OFF.”

11. Connect the ECM coupler ⓐ.

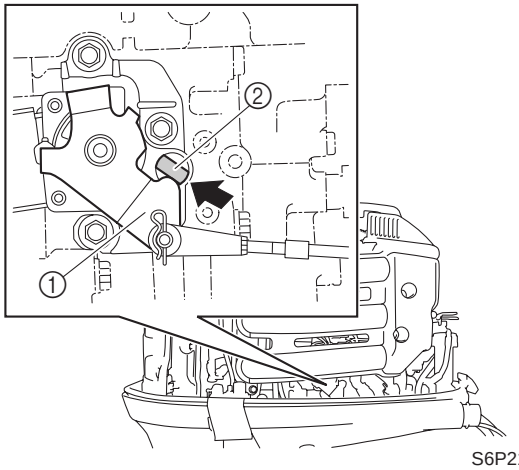
Checking the accelerator position sensor

1. Connect a computer to the outboard motor and use the YDIS to display “Accelerator position sensor 1” and “Accelerator position sensor 2.”


S6P24140

NOTE:
- Accelerator position sensor 1 and accelerator position sensor 2 are a single unit, which cannot be disassembled.
- To connect and operate the YDIS, see Chapter 9, “YDIS” and the YDIS (Ver. 1.23a or later) Instruction Manual.

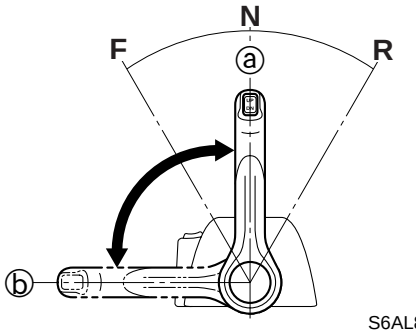
2. Check that the accelerator lever ① contacts the fully closed stopper ② when the remote control lever is at the fully closed position.



S6P21030

NOTE:
To adjust the throttle cable, see Chapter 3, “Adjusting the throttle cable.”

3. Turn the engine start switch to “ON,” operate the remote control lever, and then check the output voltages of accelerator position sensor 1 and accelerator position sensor 2 at the fully closed position ⓐ and fully open position ⓑ.



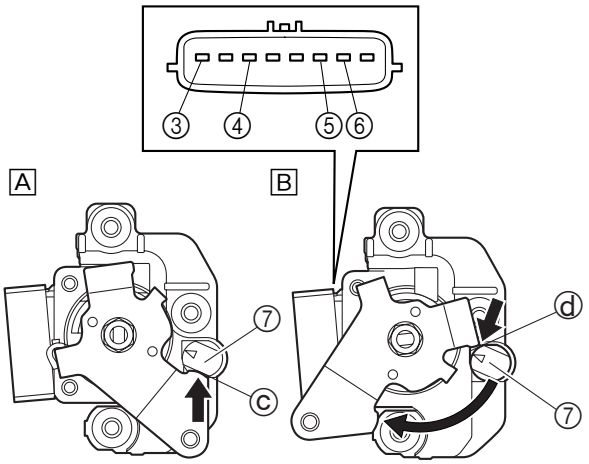
S6AL8150

NOTE:
Do not start the engine when checking the accelerator position sensor.

Accelerator position sensor output voltage

Item	Remote control lever position	
	Fully closed ⓐ	Fully open ⓑ
Sensor 1	0.550–0.850 V	Above 3.250 V (reference data)
Sensor 2	0.400–1.000 V	

4. Operate the remote control lever, and check that the output voltages of accelerator position sensor 1 and accelerator position sensor 2 change continuously.
5. Turn the engine start switch to “OFF.”
6. Disconnect the throttle cable joint from the accelerator position sensor.
7. Disconnect the accelerator position sensor coupler.
8. Operate the accelerator lever, and measure the resistance of the accelerator position sensor at the fully closed position ⓒ and fully open position ⓓ.



S6AL8160

A: Fully closed position
B: Fully open position

NOTE:
When the accelerator lever is in the fully open position ⓓ, make sure that it is contacting the stopper ⑦ when measuring the sensor resistance.

Accelerator position sensor resistance at 20 °C (68 °F) (reference data):

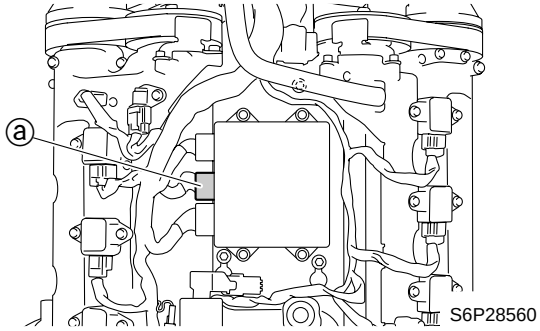
Terminal	Accelerator lever position	
	Fully closed ⓒ	Fully open ⓓ
③–④ ⑤–⑥	0.800 kΩ	5.300 kΩ

9. Connect the accelerator position sensor coupler.
10. Connect the throttle cable joint to the accelerator position sensor.

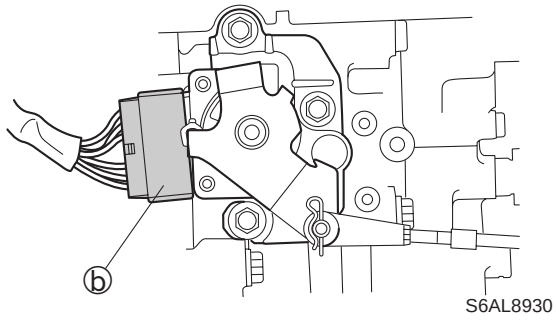
8

Checking the accelerator position sensor circuit

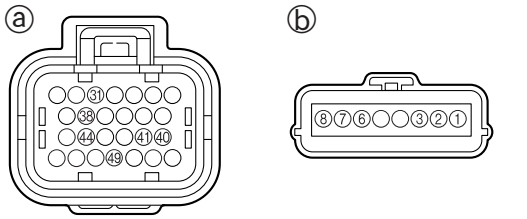
1. Disconnect the ECM coupler ⓐ.



2. Disconnect the accelerator position sensor coupler ⓑ.



3. Check the wiring harness for continuity.

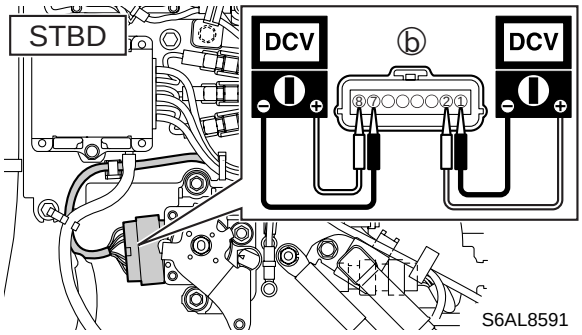


Wiring harness continuity

Terminal No.		Color
Coupler ⓐ	Coupler ⓑ	
40	1	B
44	2	O
38	3	P
31	6	P/W
41	7	B
49	8	O

4. Connect the ECM coupler ⓐ.

5. Turn the engine start switch to “ON,” and then measure the input voltage at each terminal of the accelerator position sensor coupler ⓑ (wiring harness end).



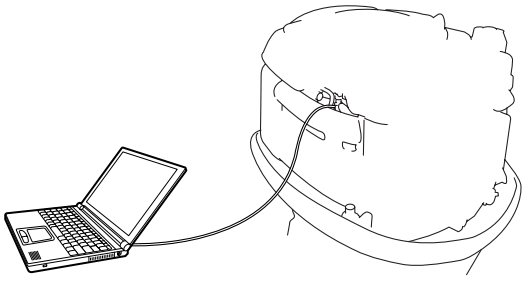
Accelerator position sensor input voltage (reference data):
Terminal ② (O) – Terminal ① (B)
Terminal ⑧ (O) – Terminal ⑦ (B)
4.75–5.25 V

6. Turn the engine start switch to “OFF.”

7. Connect the accelerator position sensor coupler ⓑ.

Checking the electronic throttle valve and TPS

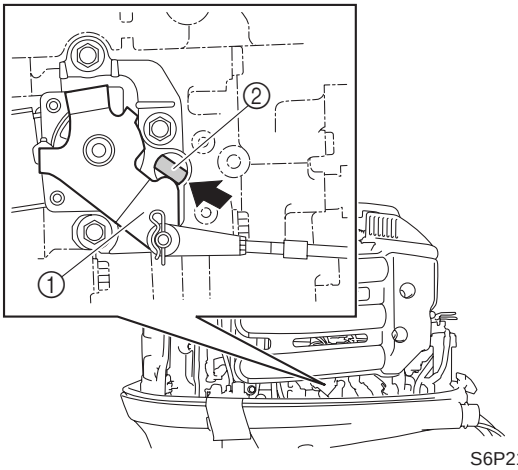
1. Connect a computer to the outboard motor and use the YDIS to display “Throttle position sensor 1,” “Throttle valve opening,” and “Throttle position sensor 2.”



S6P24140

NOTE:
- TPS 1 and TPS 2 are components of the electronic throttle valve, which cannot be disassembled.
- To connect and operate the YDIS, see Chapter 9, "YDIS" and the YDIS (Ver. 1.23a or later) Instruction Manual.

2. Check that the accelerator lever ① contacts the fully closed stopper ② when the remote control lever is at the fully closed position.

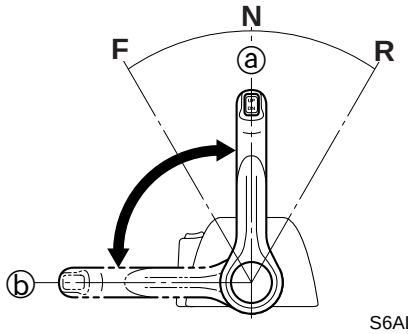


S6P21030

NOTE:
To adjust the throttle cable, see Chapter 3, "Adjusting the throttle cable."

3. Start the engine, warm it up, and then turn it off.

4. Turn the engine start switch to "ON," operate the remote control lever, and then check the output voltages of TPS 1 and TPS 2 and the throttle valve opening angle at the fully closed position ⓐ and fully open position ⓑ.



S6AL8150

NOTE:
- Check the TPS after the engine has been warmed up.
- When checking the TPS using the YDIS, do not start the engine.
- The actual TPS output voltage and throttle valve opening angle may vary according to environmental conditions and engine temperature.

TPS output voltage and throttle valve opening angle (reference data):

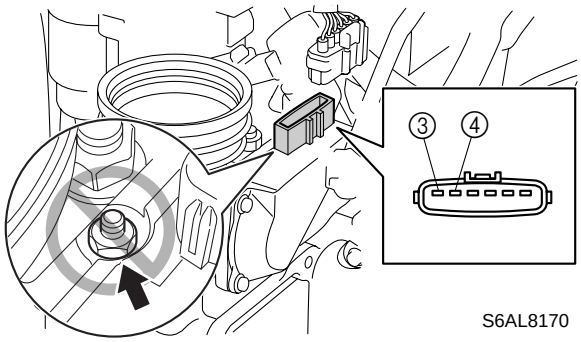
Item	Remote control lever position	
	Fully closed ⓐ	Fully open ⓑ
TPS 1	0.750 V at 20 °C (68 °F)	—
TPS 2	—	4.550 V at 20 °C (68 °F)
Throttle valve opening angle	0.5–7.0°	Above 39.8° (F(L)200C)
		Above 53.8° (F(L)225B)

5. Operate the remote control lever, and check that the output voltages of TPS 1 and TPS 2 change continuously.

6. Turn the engine start switch to "OFF."

7. Disconnect the electronic throttle valve coupler.

8. Measure the electronic throttle valve motor resistance between the terminals ③ and ④.



CAUTION:

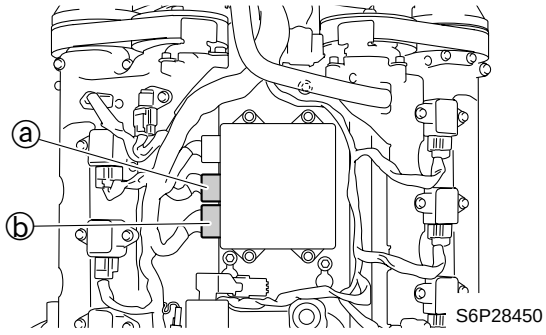
Do not loosen the throttle stop screw nut, and do not turn the throttle stop screw.

Electronic throttle valve motor resistance Terminal ③ – Terminal ④ (reference data):
1.23–1.67 Ω at 20–30 °C
(68–86 °F)

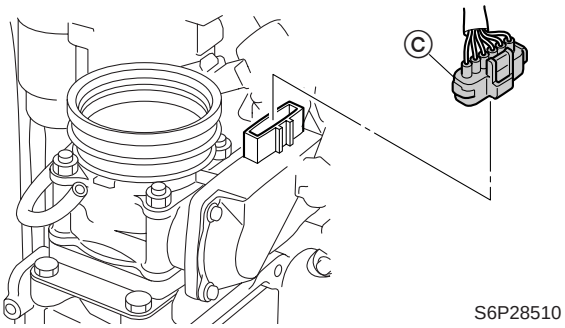
9. Connect the electronic throttle valve coupler.

Checking the electronic throttle valve and TPS circuit

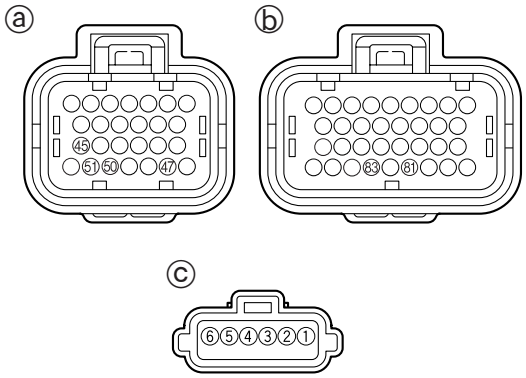
1. Disconnect the ECM couplers ⓐ and ⓑ.



2. Disconnect the electronic throttle valve coupler ⓒ.



3. Check the wiring harness for continuity.

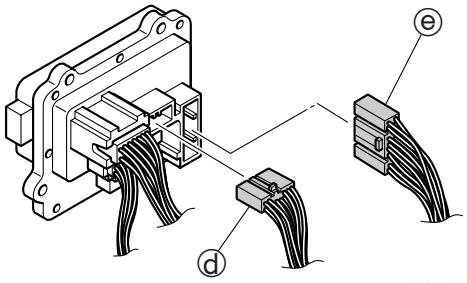


Wiring harness continuity

Terminal No.		Color
Coupler ⓐ, ⓑ	Coupler ⓒ	
83	1	G/R
81	2	G/B
47	3	B
45	4	P
51	5	O
50	6	P/W

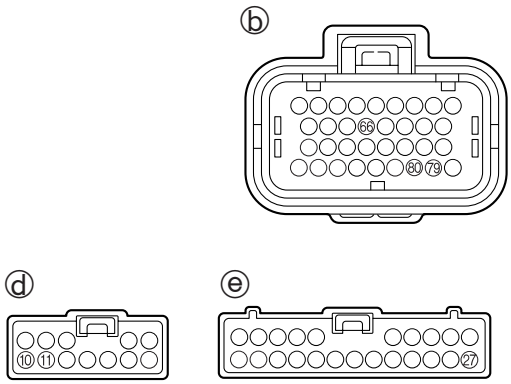
4. Connect the electronic throttle valve couplers ⓐ and ⓒ.

5. Disconnect the fuse holder couplers ⓓ and ⓔ.



S6P28530

6. Check the wiring harness for continuity.



S6P28840

NOTE:
Depending on the outboard motor, the location of the red/green terminals (79 and 80) of the coupler ⓑ may be switched.

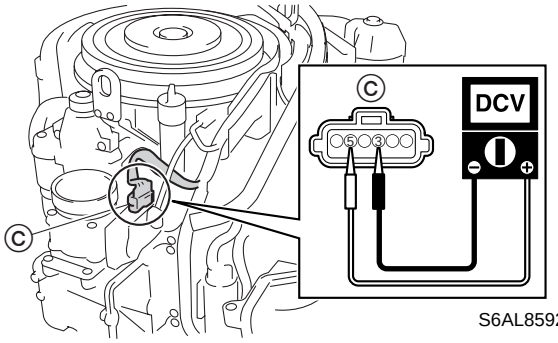
Wiring harness continuity

Terminal No.		Color
Coupler ⓑ	Coupler ⓓ, ⓔ	
79	10	R/G
80	11	R/G
66	27	Y

7. Connect the ECM coupler ⓑ and fuse holder couplers ⓓ and ⓔ.

8. Disconnect the electronic throttle valve coupler ⓒ.

9. Turn the engine start switch to “ON,” and then measure the TPS input voltage at the electronic throttle valve coupler ⓒ (wiring harness end).



S6AL8592

TPS input voltage (reference data):
Terminal ⑤ (O) – Terminal ③ (B):
4.75–5.25 V

10. Turn the engine start switch to “OFF.”

11. Connect the electronic throttle valve coupler ⓒ.

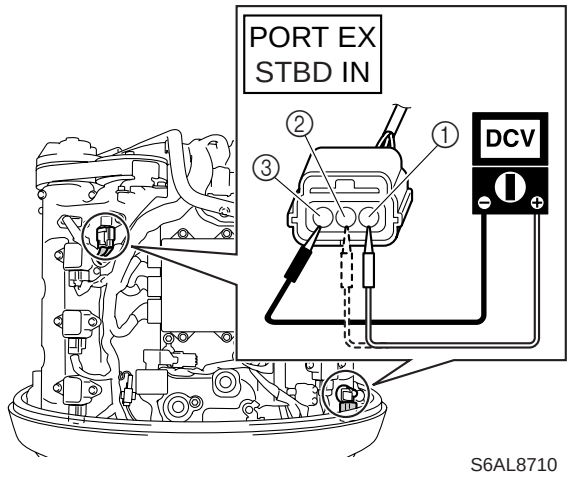
Variable camshaft timing control system

Checking the cam position sensor

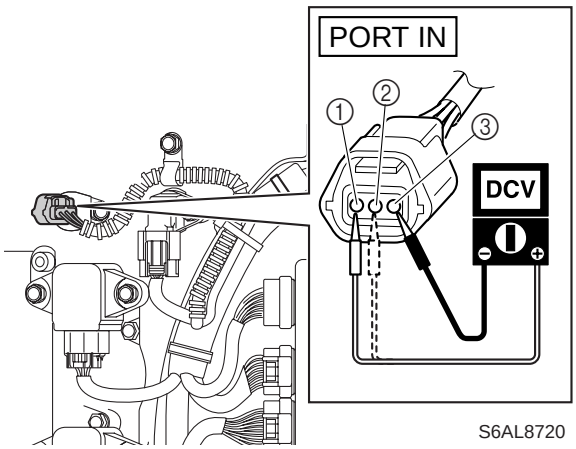
1. Disconnect the cam position sensor couplers.

8

2. Turn the engine start switch to “ON,” and then measure the input voltage at the cam position sensor coupler (wiring harness end). Check the wiring harness if below specification.



S6AL8710



S6AL8720

Cam position sensor input voltage:
Red/yellow (R/Y) ① – Black (B) ③
12 V (battery voltage)
Cam position sensor output voltage:
White/blue (W/L) ② – Black (B) ③ (PORT EX)
White/black (W/B) ② – Black (B) ③ (STBD IN)
White/green (W/G) ② – Black (B) ③ (PORT IN)
4.75–5.25 V (reference data)

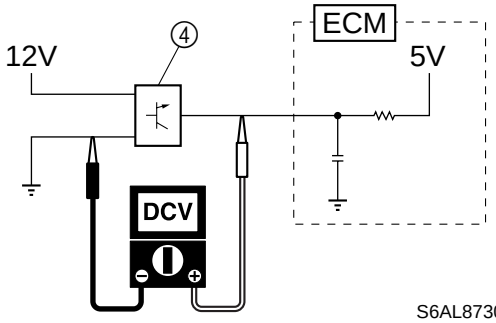
3. Turn the engine start switch to “OFF.”

4. Remove the cam position sensors ④.

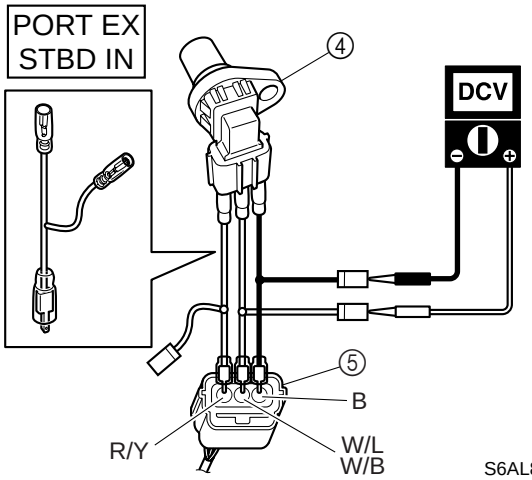
5. Connect the wire leads between cam position sensor and cam position sensor coupler ⑤ (wiring harness end) as shown.

NOTE:
Be sure to connect the wire leads to the corresponding terminals.

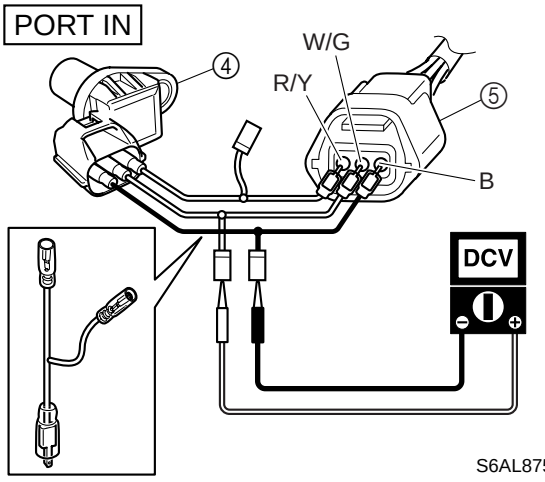
6. Connect the tester leads to the wire leads.



S6AL8730

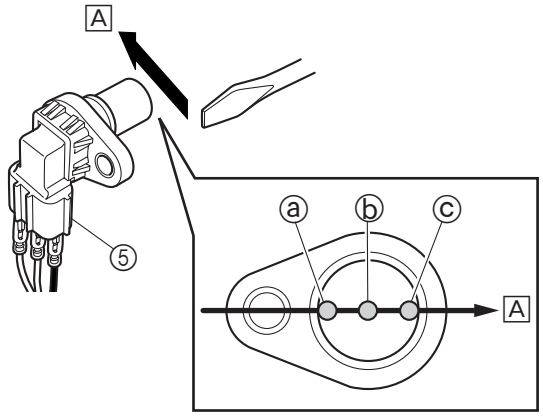


S6AL8740



S6AL8750

7. Turn the engine start switch to “ON,” and then measure the output voltage when moving the screwdriver close to the sensor. Replace the cam position sensor if out of specification.



S6AL8760

NOTE:
Be sure to move the screwdriver in front of the cam position sensor in direction A as shown, otherwise the correct output voltage measurement cannot be obtained.

Cam position sensor output voltage:
White/blue (W/L) – Black (B) (PORT EX)
White/black (W/B) – Black (B) (STBD IN)

Position	Voltage (V)
ⓐ, ⓒ	More than 4.8
ⓑ	Less than 1.0

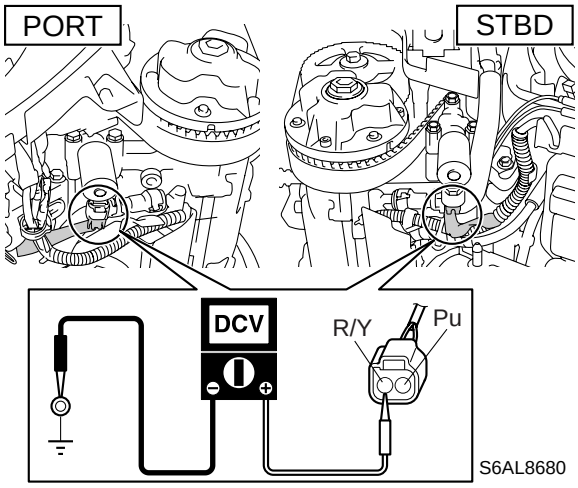
White/green (W/G) – Black (B) (PORT IN)

Position	Voltage (V)
ⓐ, ⓒ	Less than 1.0
ⓑ	More than 4.8

8. Turn the engine start switch to “OFF.”
9. Disconnect the wire leads.
10. Install the cam position sensors.
11. Connect the cam position sensor couplers, and then install all parts removed during disassembly.

Checking the oil control valve

1. Check the operation of the oil control valves using the “Stationary test” of the YDIS and listen for the operating sound.
2. Disconnect the oil control valve couplers.
3. Turn the engine start switch to “ON,” and then measure the input voltage between the oil control valve coupler and ground. Check the wiring harness if below specification.

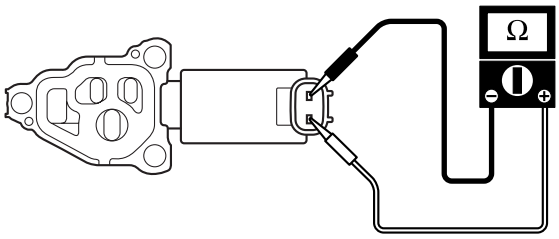


S6AL8680

Oil control valve input voltage:
Red/yellow (R/Y) – Ground
12 V (battery voltage)

4. Turn the engine start switch to “OFF.”

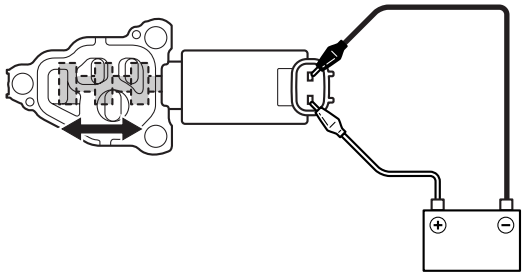
5. Measure the oil control valve resistance. Replace the oil control valve if out of specification.



S6AL8690

Oil control valve resistance:
6.7–7.7 Ω at 20 °C (68 °F)

6. Connect the battery leads to the oil control valve terminals and check the operation of the spool valve. Replace the oil control valve if it does not operate.



S6AL8700

7. Disconnect the battery leads from the oil control valve terminals, and then connect the oil control valve couplers.

Fuel control system

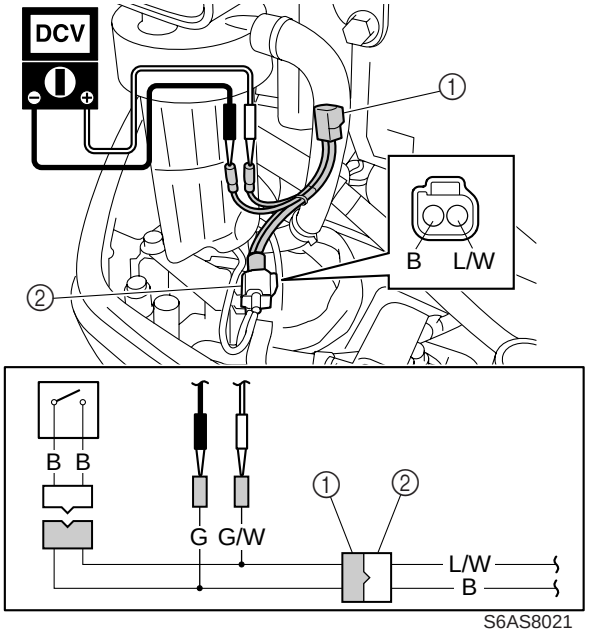
Checking the water detection switch

NOTE:
Be sure to check the water detection switch each time the fuel filter is checked.

1. Disconnect the water detection switch coupler (blue).

2. Connect the test harness (2 pins) ① to the water detection switch coupler (wiring harness end) ②.

3. Turn the engine start switch to "ON," and then measure the input voltage at the water detection switch coupler (wiring harness end). Check the wiring harness if out of specification.



S6AS8021

Test harness (2 pins) ①:
90890-06867

Water detection switch input voltage (reference data):
Blue/white (L/W)–Black (B)
4.75–5.25V

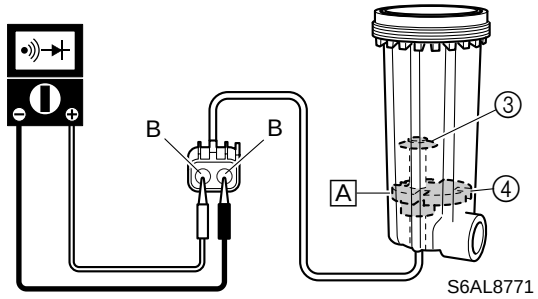
4. Turn the engine start switch to "OFF."

5. Disconnect the test harness (2 pins) ① from the water detection switch coupler (wiring harness end) ②.

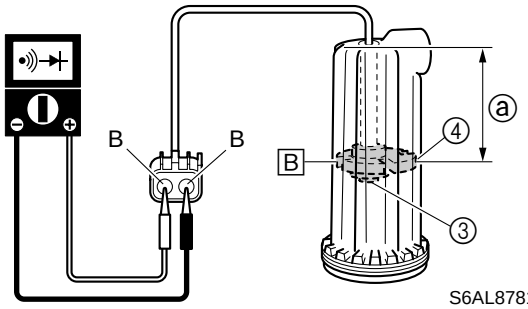
6. Remove the fuel filter cup assembly.

NOTE:
Do not twist the water detection switch lead when removing the fuel filter cup assembly.

7. Check the water detection switch for continuity with the float in positions [A] and [B]. Replace the fuel filter cup assembly if out of specification.



S6AL8771



S6AL8781

NOTE:
- Before checking the water detection switch, make sure that the float ④ is able to move to positions A and B as shown.
- Be sure not to remove the clip ③ and float ④, otherwise the water detection switch may be damaged.

Float height:
Water detection position ⓐ:
30 mm (1.18 in)

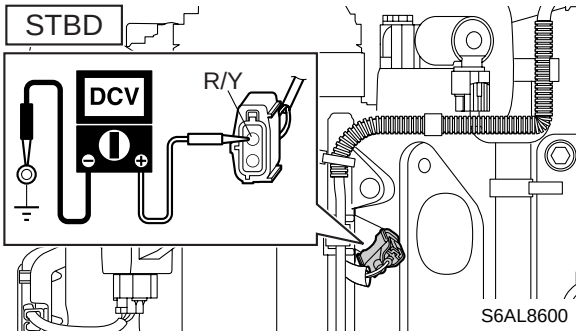
Float position	Lead color	
	Black (B)	Black (B)
A		
B	○	○

8. Install the fuel filter cup assembly and connect the water direction switch caupler (blue).

NOTE:
Do not twist the water detection switch lead when installing the fuel filter cup assembly.

Checking the fuel injector

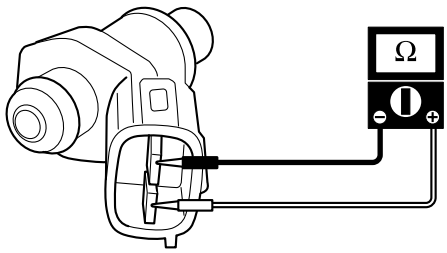
1. Check the operation of the fuel injectors using the “Stationary test” of the YDIS and listen for the operating sound.
2. Disconnect the fuel injector couplers.
3. Turn the engine start switch to “ON,” and then measure the input voltage between the fuel injector coupler terminal and ground. Check the wiring harness if below specification.



S6AL8600

Fuel injector input voltage:
Red/yellow (R/Y) – Ground
12 V (battery voltage)

4. Turn the engine start switch to “OFF.”
5. Measure the fuel injector resistance.



S6AL8610

Fuel injector resistance
(reference data):
12.0 Ω at 21 °C (70 °F)

6. Connect the fuel injector couplers.

8

Checking the low-pressure fuel pump and high-pressure fuel pump

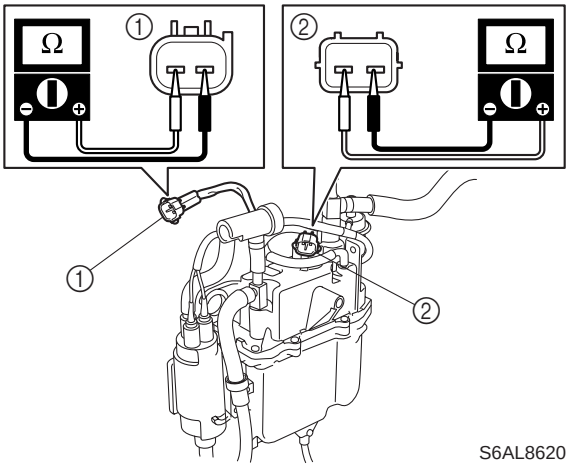
1. Check the fuses for continuity. Replace if there is no continuity.

NOTE:
For the location of the fuse, see Chapter 8, "Fuse holder."

2. Check the operation of the low-pressure fuel pump and high-pressure fuel pump using the "Stationary test" of the YDIS and listen for the operating sound.

3. Disconnect the low-pressure fuel pump coupler ① and high-pressure fuel pump coupler ②.

4. Measure the resistance of the fuel pump motors.



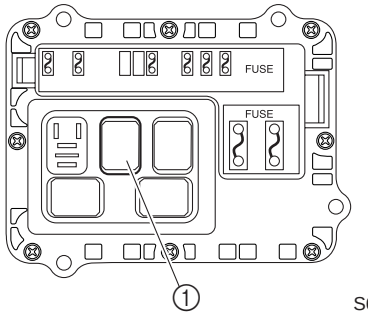
S6AL8620

Low-pressure fuel pump resistance ① (reference data):
1.3–4.0 Ω
High-pressure fuel pump resistance ② (reference data):
0.5–10 Ω

5. Connect the low-pressure fuel pump coupler ① and high-pressure fuel pump coupler ②.

Checking the high-pressure fuel pump relay

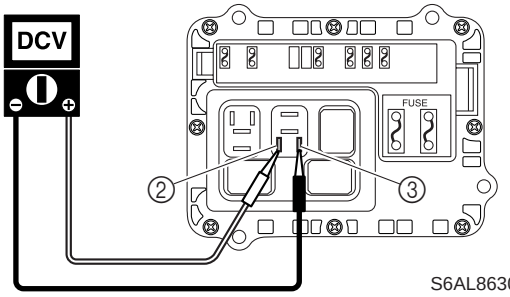
1. Remove the high-pressure fuel pump relay ① and check it.



S6P28180

NOTE:
The high-pressure fuel pump relay and main relay are the same type of relay. To check the relay, see Chapter 8, "Checking the main relay and electronic throttle valve relay."

2. Connect the tester leads to terminals ② and ③ as shown, turn the engine start switch to "ON," and then measure the voltage within 5 seconds after turning the switch to "ON."

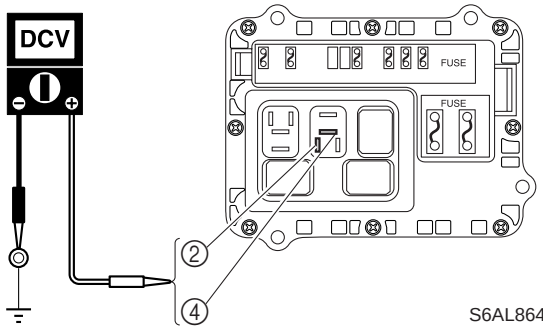


S6AL8630

NOTE:
When the engine start switch is turned to "ON," voltage is supplied to the high-pressure fuel pump relay and the high-pressure fuel pump operates. After 5 seconds, the power to the relay turns off and the fuel pump stops.

Terminal ② – Terminal ③:
12 V (battery voltage)

3. Measure the input voltage between the terminal ② and ground, and the terminal ④ and ground as shown.



Terminal ② – Ground:
Terminal ④ – Ground:
12 V (battery voltage)

4. Turn the engine start switch to “OFF.”

5. Install the high-pressure fuel pump relay, and then install all parts removed during disassembly.

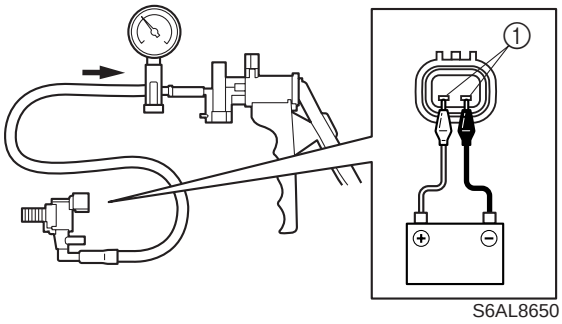
Checking the vapor shut-off valve

1. Connect the special service tool to the vapor shut-off valve as shown.

2. Apply the specified negative pressure to the vapor shut-off valve.

3. Check that the vapor shut-off valve opens and the negative pressure is released when the battery voltage is applied to the vapor shut-off valve terminals ①.

NOTE:
Apply the battery voltage to the vapor shut-off valve terminals for a few seconds only, otherwise the vapor-shut off valve may be damaged.



Vacuum/pressure pump gauge set:
90890-06756

Specified negative pressure:
67 kPa (0.7 kgf/cm^2, 9.7 psi)

4. Measure the resistance between the vapor shut-off valve terminals ①.

Vapor shut-off valve resistance (reference data):
30.0–34.0 Ω at 20 °C (68 °F)

Starting system

Checking the fuse

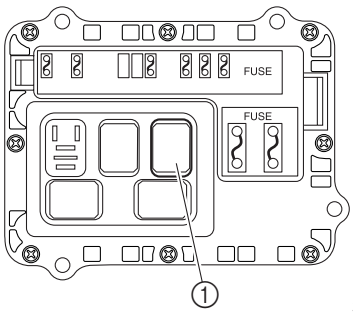
1. Check the fuses for continuity. Replace if there is no continuity.

NOTE:
For the location of the fuse, see Chapter 8, “Fuse holder.”

8

Checking the starter relay

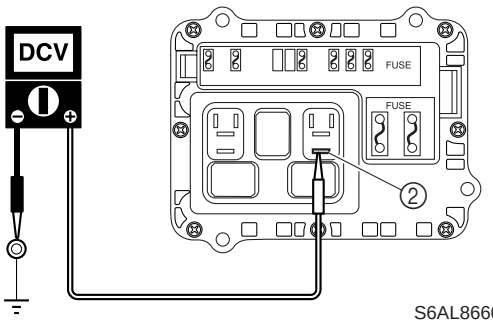
1. Remove the starter relay ① and check it.



S6P28190

NOTE:
The high-pressure fuel pump relay and main relay are the same type of relay. To check the relay, see Chapter 8, “Checking the main relay and electronic throttle valve relay.”

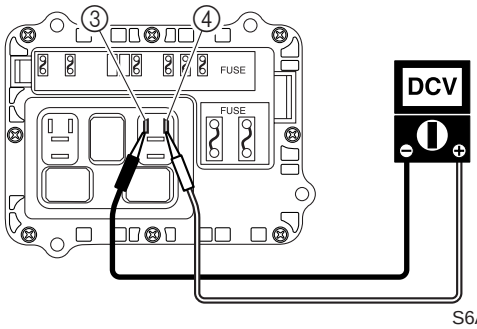
2. Measure the input voltage between the terminal ② and ground as shown.



S6AL8660

Terminal ② – Ground:
12 V (battery voltage)

3. Connect the tester leads between the terminals ③ and ④ as shown, and then turn the engine start switch to “START” and measure the input voltage.



S6AL8670

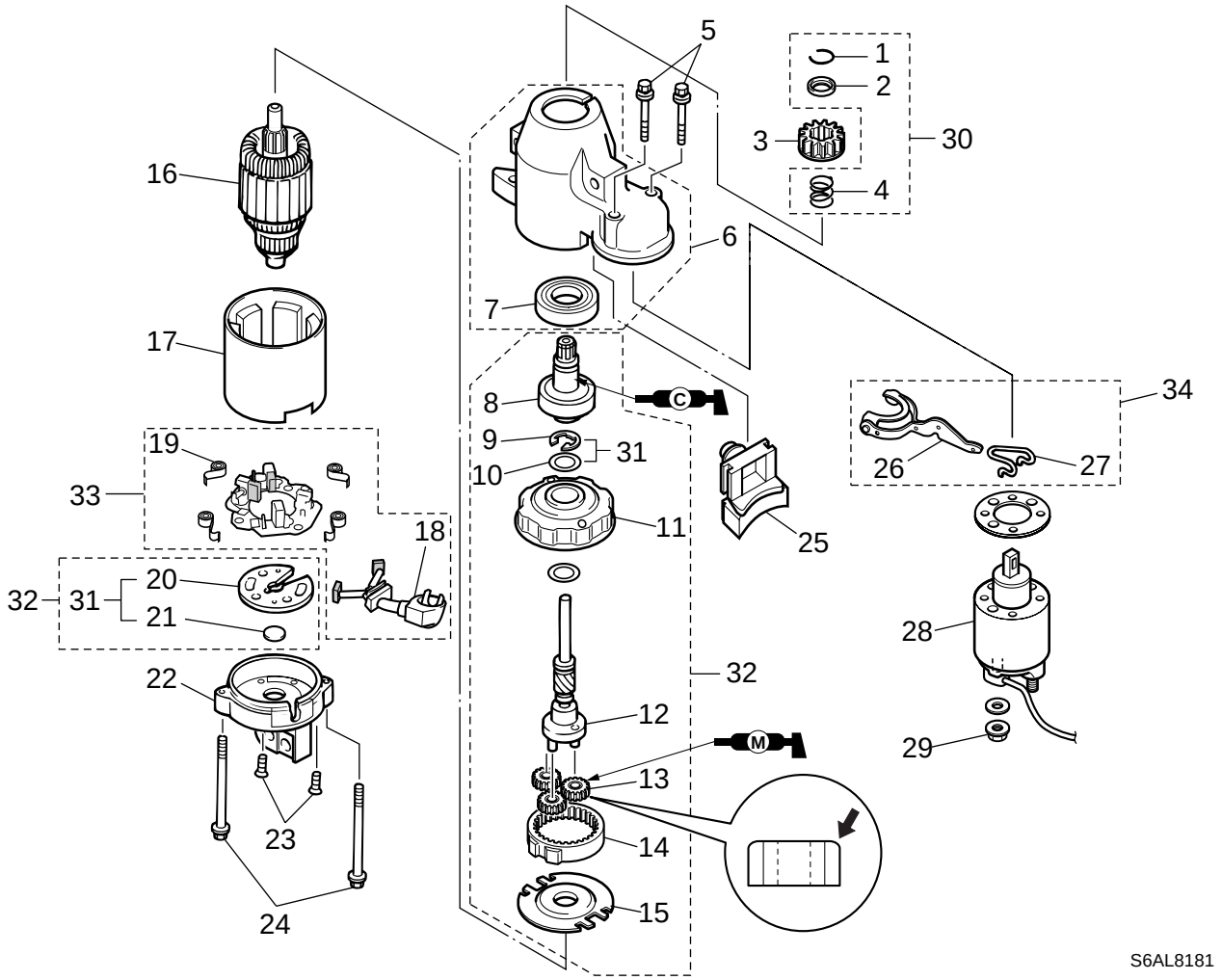
Terminal ③ – Terminal ④:
12 V (battery voltage)

NOTE:
To check the engine start switch, see Chapter 8, “Checking the engine start switch.”

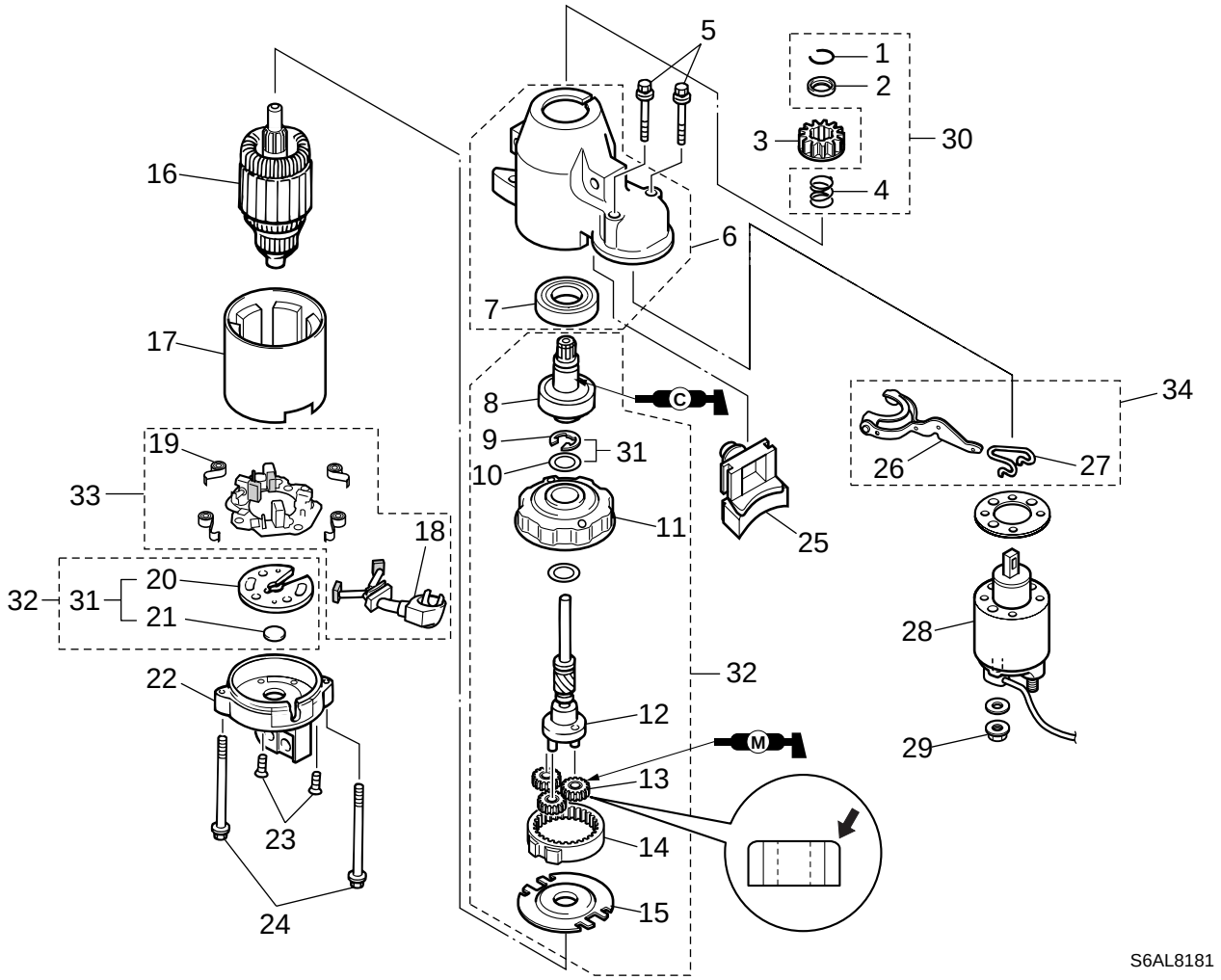
4. Turn the engine start switch to “OFF.”

5. Install the starter relay, and then install all parts removed during disassembly.

Starter motor



No.	Part name	Q'ty	Remarks
1	Clip	1	
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	M6 × 35 mm
6	Cover assembly	1	
7	Bearing	1	
8	Clutch assembly	1	
9	E-clip	1	**Not reusable**
10	Washer	1	
11	Bracket	1	
12	Pinion shaft	1	
13	Planetary gear	3	
14	Outer gear	1	
15	Plate	1	
16	Armature	1	
17	Stator	1	



No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Plate	1	
21	Plate	1	
22	Bracket	1	
23	Screw	2	ø4 × 15 mm
24	Bolt	2	M6 × 120 mm
25	Rubber seal	1	
26	Shift lever	1	
27	Spring	1	
28	Magnet switch assembly	1	
29	Nut	1	
30	Pinion stopper set	1	
31	Washer set	1	
32	Starting motor gear assembly	1	
33	Brush holder assembly	1	
34	Lever assembly	1	

Removing the starter motor

1. Remove the starboard intake manifold and intake silencer.

NOTE:
To remove the intake manifold, see Chapter 4, “Intake manifold.”

2. Remove the starter motor from the power unit.

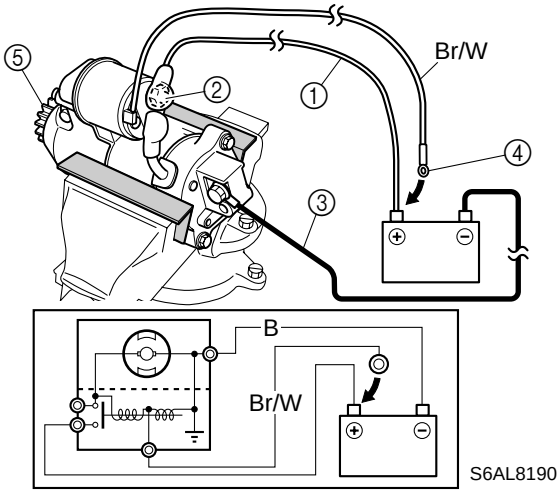
NOTE:
- Check the engine start switch, starter relay, and starter relay fuse before removing the starter motor.
- To remove the starter motor, see Chapter 5, “Starter motor.”

Checking the starter motor operation

1. Hold the starter motor in a vise using aluminum plates on both sides.

2. Connect the positive battery cable ① to the magnet switch terminal ②, and connect the negative battery cable ③ to the starter motor body as shown.

3. Connect the starter motor lead (brown/white) ④ to the positive battery terminal, and then check the starter motor operation.



⚠ WARNING

The pinion ⑤ moves slightly away from the starter motor body and rotates at high speed, so do not place any objects near the pinion or touch it.

NOTE:
- Check the starter motor operation for a few seconds.
- If the starter motor is disassembled for maintenance, be sure to check the operation again after assembling it.

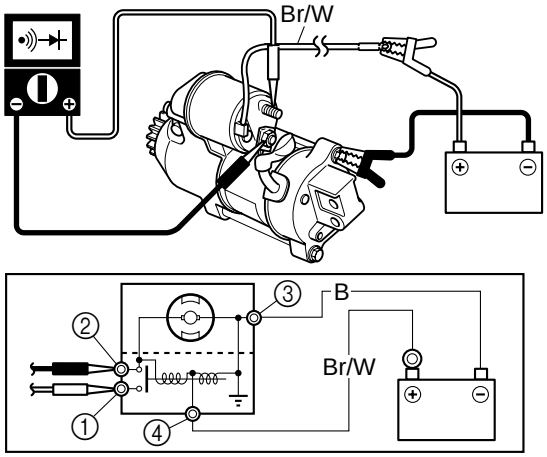
4. Disconnect the negative battery cable and positive battery cable from the battery terminals.

Checking the magnet switch

1. Connect the tester leads between the magnet switch terminals ① and ② as shown.

2. Connect the negative battery cable to the starter motor body ③.

3. Connect the positive battery cable to the starter motor lead (brown/white) ④, and then check the magnet switch continuity.



S6AL8200

CAUTION:

Do not connect the starter motor lead (brown/white) to the battery for more than 1 second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals ① and ②. Replace if there is no continuity.

Battery lead	Magnet switch terminal No.	
	①	②
Connect	○	○
Disconnect		

5. Check that there is no continuity between the magnet switch terminal ① and starter motor body ③ when the negative battery terminal is removed from the starter motor body. Replace if there is continuity.

NOTE:

- The starter motor pinion should be pushed out while the magnet switch is "ON."
- If the starter motor is disassembled for maintenance, be sure to check the magnet switch again after assembling it.

6. Disconnect the negative battery cable and positive battery cable from the battery terminals.

Checking the starter motor pinion

CAUTION:

Be sure to disconnect the battery cables before checking the starter motor pinion.

1. Check the pinion teeth. Replace the pinion if cracked or worn.

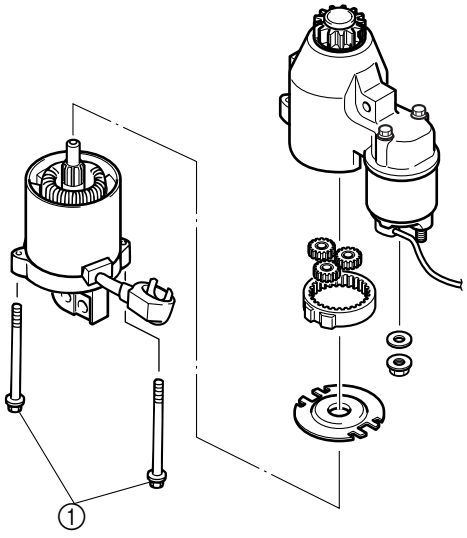
2. Check for smooth operation.

NOTE:

Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

Disassembling the starter motor

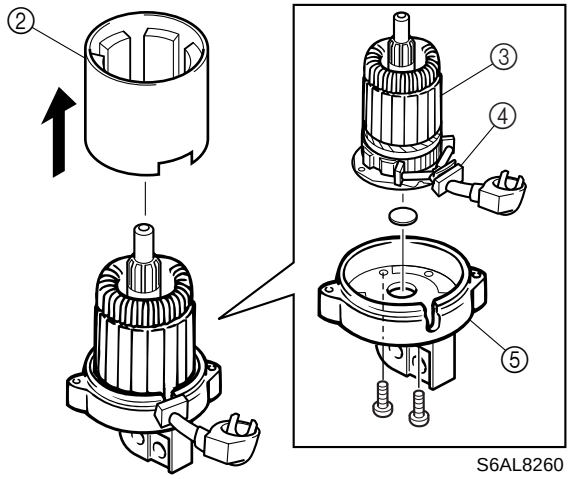
1. Remove the bolts ①, and then disassemble the starter motor body.



S6AL8230

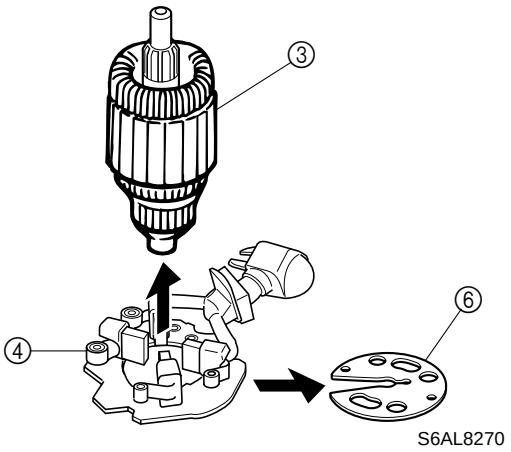
2. Remove the stator ②.

3. Remove the armature ③ with the brush holder assembly ④ from the bracket ⑤.



S6AL8260

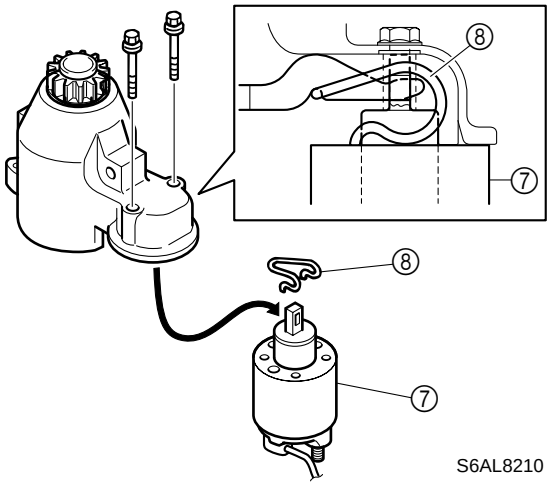
4. Remove the plate ⑥, and then remove the armature ③ from the brush holder assembly ④.



S6AL8270

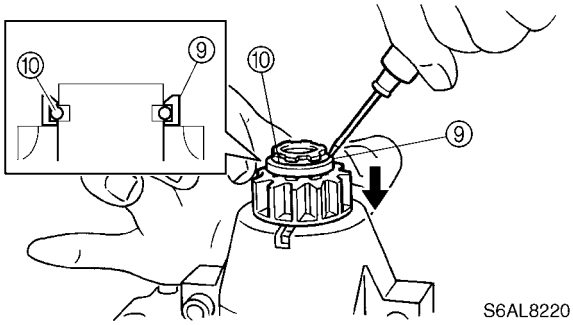
NOTE:
Do not scratch or damage the brushes when removing the armature.

5. Remove the magnet switch ⑦ and spring ⑧.



S6AL8210

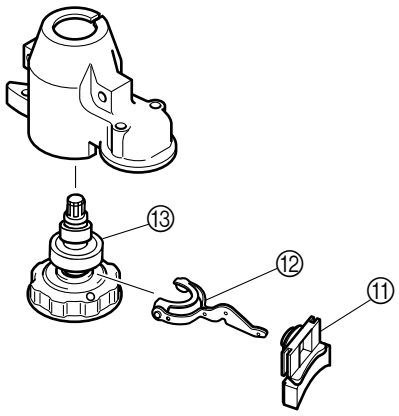
6. Slide the pinion stopper ⑨ down as shown, and then remove the clip ⑩.



S6AL8220

NOTE:
Remove the clip with a screwdriver.

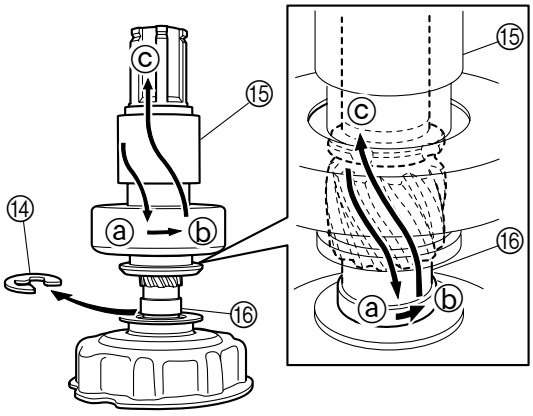
7. Remove the rubber seal ⑪, shift lever ⑫ and pinion shaft assembly ⑬.



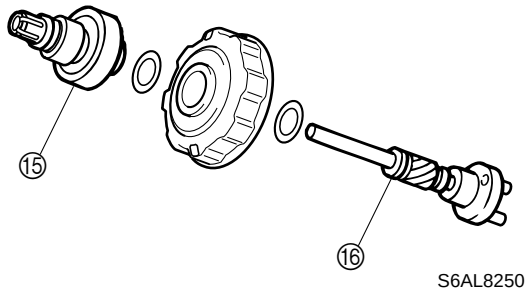
S6AL8790

8

8. Remove the E-clip ⑭, and then remove the clutch assembly ⑮ from the pinion shaft ⑯.



S6AL8240

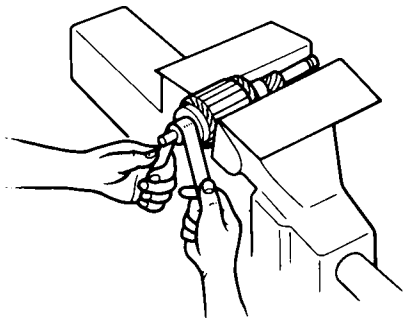


S6AL8250

NOTE:
Push the clutch assembly ⑮ completely down onto the pinion shaft ⑯ in direction ⓐ, rotate it 1 spline in direction ⓑ, and then remove it in direction ⓒ.

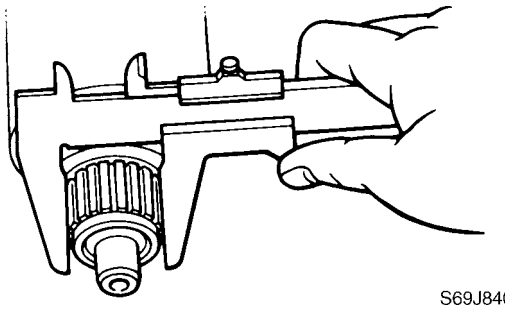
Checking the starter motor

1. Check the commutator. Clean with 600–grit sandpaper and compressed air if dirty.



S69J7185

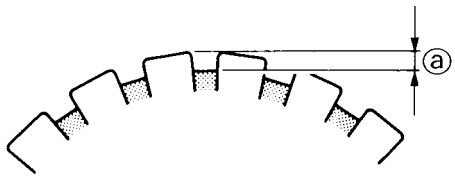
2. Measure the commutator diameter. Replace the armature if below specification.



S69J8400

Commutator standard diameter:
29.0 mm (1.14 in)
Wear limit: 28.0 mm (1.10 in)

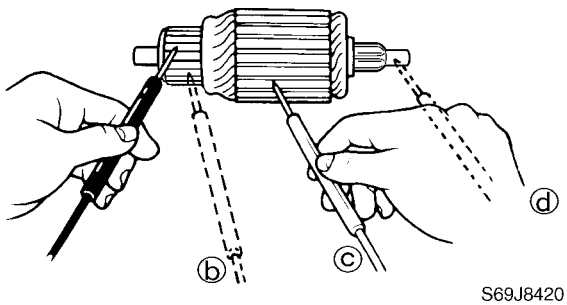
3. Measure the commutator undercut ⓐ. Replace the armature if below specification.



S69J8410

Commutator standard undercut ⓐ:
0.8 mm (0.03 in)
Wear limit: 0.2 mm (0.01 in)

4. Check the armature for continuity. Replace the armature if out of specifications.

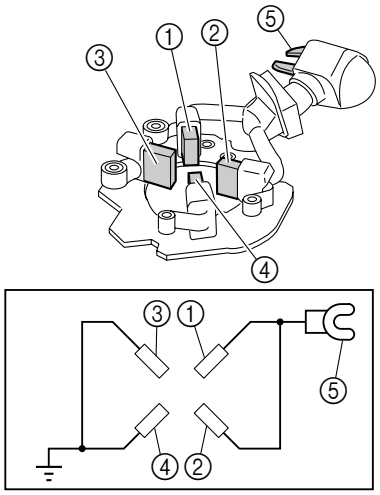


S69J8420

Armature continuity	
Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

Checking the brush

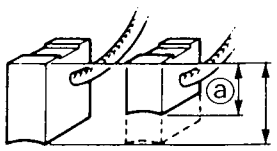
1. Check the brush holder assembly for continuity. Replace the brush holder assembly if out of specification.



S6AL8280

Brush holder assembly continuity	
Brush ① – Brush ② Brush ① – Terminal ⑤ Brush ② – Terminal ⑤ Brush ③ – Brush ④	Continuity
For all brush and terminal combinations not listed above.	No continuity

2. Measure the length of each brush. Replace the brush assembly if below specification.



S69J8430

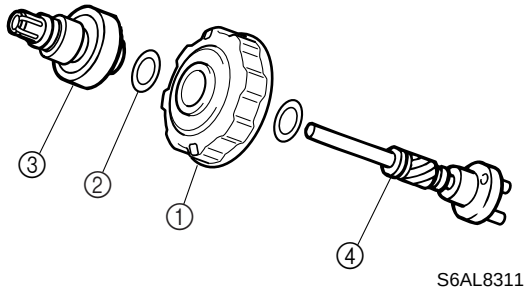
Brush standard length:
15.5 mm (0.61 in)
Wear limit ⓐ: 9.5 mm (0.37 in)

Assembling the starter motor

CAUTION:

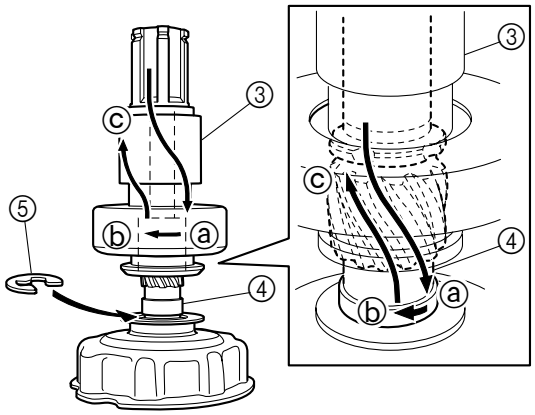
Do not allow grease or oil to contact the commutator of the armature.

1. Install the bracket ①, washer ② and clutch assembly ③ onto the pinion shaft ④.



S6AL8311

2. Confirm that the clutch assembly ③ is properly installed onto the pinion shaft ④ and will not come loose, and then install the E-clip ⑤.



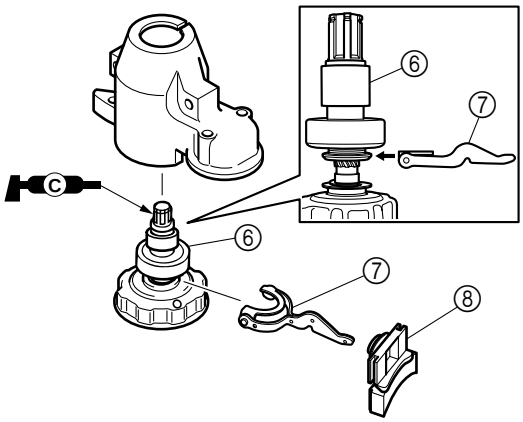
S6AL8320

NOTE:

Push the clutch assembly ③ completely down onto the pinion shaft ④ in direction ⓐ, rotate it 1 spline in direction ⓑ, and then slide it in direction ⓒ.

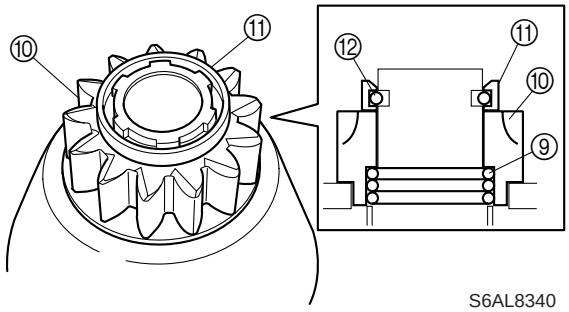
8

3. Install the pinion shaft assembly ⑥, shift lever ⑦ and rubber seal ⑧.



S6AL8800

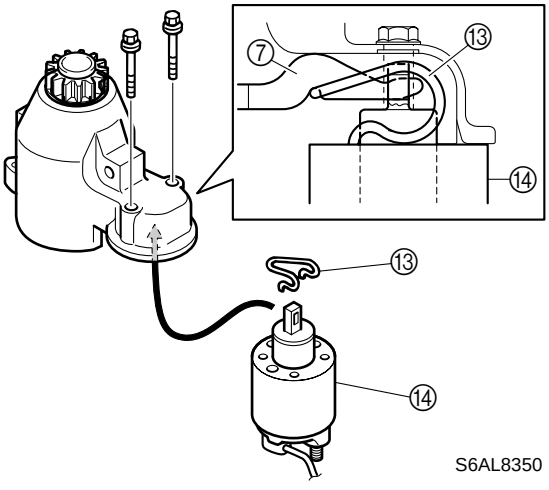
4. Install the spring ⑨, pinion ⑩, pinion stopper ⑪ and clip ⑫.



S6AL8340

NOTE:
Be sure to install the clip ⑫ into the slot of the pinion stopper ⑪.

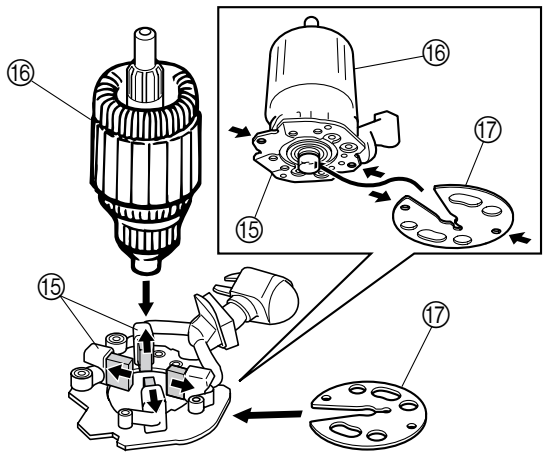
5. Install the spring ⑬ and magnet switch ⑭.



S6AL8350

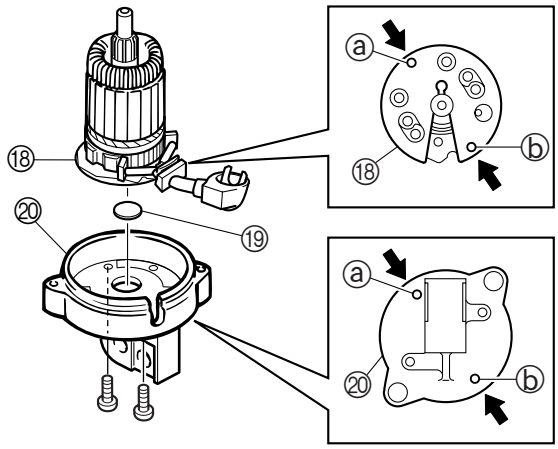
6. Push the brushes ⑮ into the holders, and then install the armature ⑯ to the brush holder assembly.

7. Install the plate ⑰.



S6AL8290

8. Align the screw holes in the brush holder with the holes ⓐ and ⓑ in the plate ⑱, and then install the plate ⑲ and bracket ⑳.

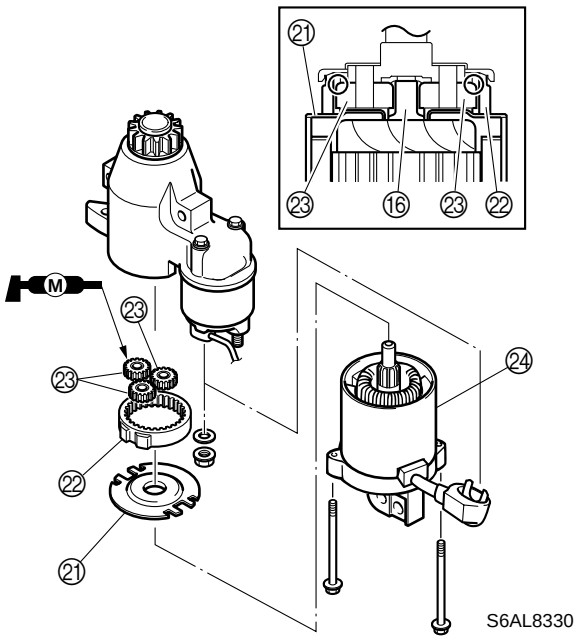


S6AL8300

NOTE:
Align the holes ⓐ and ⓑ in the plate ⑱ with the holes ⓐ and ⓑ in the bracket ⑳.

9. Install the plate ㉑, outer gear ㉒ and planetary gears ㉓ onto the armature assembly ㉔.

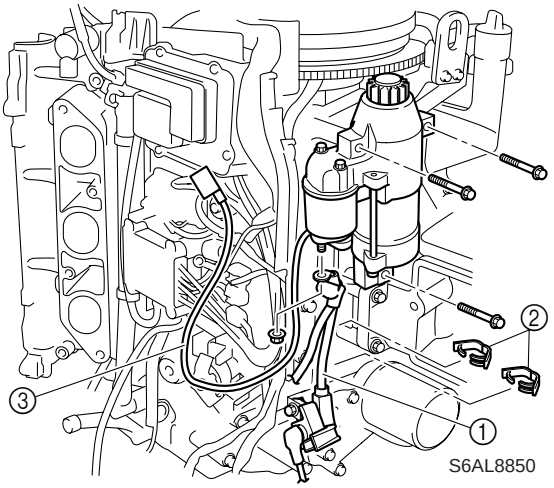
10. Assemble the starter motor body.



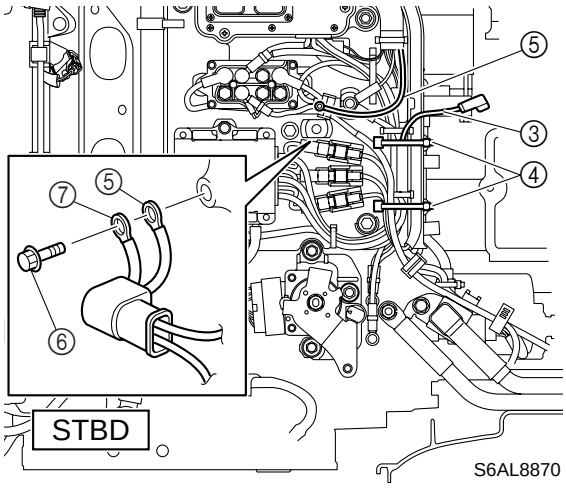
NOTE:
- Install each planetary gear ㉓ with its rounded side facing upward.
- Check the operation of the starter motor before installing it to the power unit. To check the operation of the starter motor, see Chapter 8, "Checking the starter motor operation."

Installing the starter motor

1. Install the starter motor to the power unit.
2. Install the wiring harness ① to the starter motor, and then fasten the wiring harness ① and starter motor lead (brown/white) ③ with the holders ②.



3. Route the starter motor lead (brown/white) ③ as shown, fasten it to the junction box using the plastic ties ④, and then install the terminals of the starter motor lead (brown/white) ⑦ and wiring harness lead (brown) ⑤ using the same bolt ⑥.



NOTE:
To wire the starter motor lead (brown/white), see Chapter 8, "Wiring harness routing."

4. Install the starboard intake manifold and intake silencer.

NOTE:
To install the intake manifold, see Chapter 4, "Installing the intake manifold."

Charging system

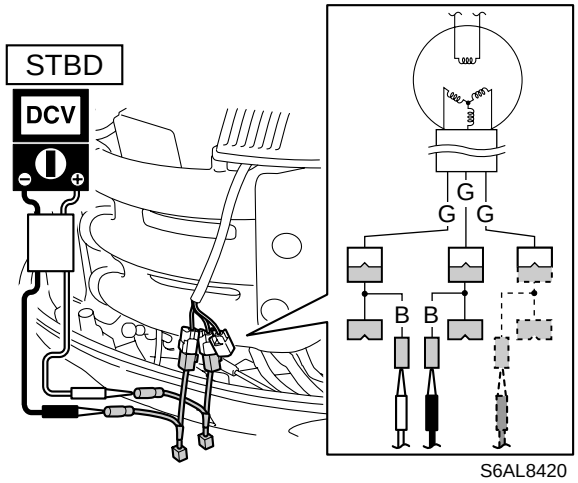
Checking the stator coil

1. Remove the starboard intake manifold.
2. Disconnect the stator coil couplers, and then install the starboard intake manifold.

NOTE:
- When installing the starboard intake manifold at this time, be sure to leave the stator coil couplers on the outside of the manifold.
- To install the starboard intake manifold, see Chapter 4, "Installing the intake manifold."

3. Connect the test harness (1 pin) ① to any stator coil coupler.

4. Measure the stator coil output peak voltage. Replace the stator coil if below specification.



S6AL8420

NOTE:
Select any 2 of the 3 couplers (leads) and measure the output peak voltage between the selected couplers. Then, measure the output voltage between the coupler that was not measured and any coupler.

Test harness (1 pin) ①:
90890-06888
Peak voltage adapter B:
90890-03172

Stator coil output peak voltage:
Green (G) – Green (G)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	8.3	44.7	97.7

5. Measure the stator coil resistance.

NOTE:
Select any 2 of the 3 couplers (leads) and measure the resistance between the selected couplers. Then, measure the resistance between the coupler that was not measured and any coupler.

Stator coil resistance
(reference data):
Green (G) – Green (G)
0.1144–0.1716 Ω at
20 °C (68 °F)

Checking the Rectifier Regulator

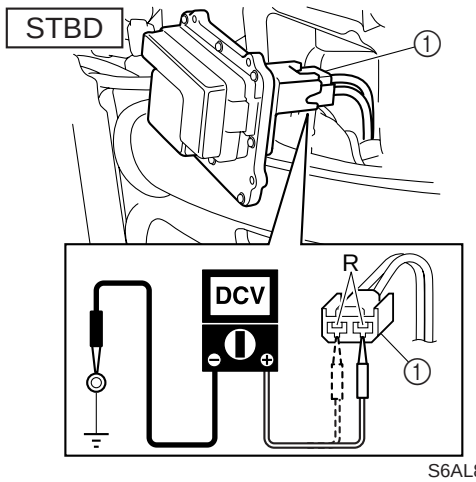
CAUTION:
If the battery cables are connected in reverse, the Rectifier Regulator can be damaged.

1. Remove the starboard intake manifold.

2. Remove the fuse holder and disconnect the Rectifier Regulator coupler ①, and then install the starboard intake manifold.

NOTE:
- When installing the starboard intake manifold at this time, be sure to leave the Rectifier Regulator coupler on the outside of the manifold.
- To install the starboard intake manifold, see Chapter 4, “Installing the intake manifold.”

3. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output peak voltage. Check the Rectifier Regulator if the output peak voltage of the stator coil is above specification.

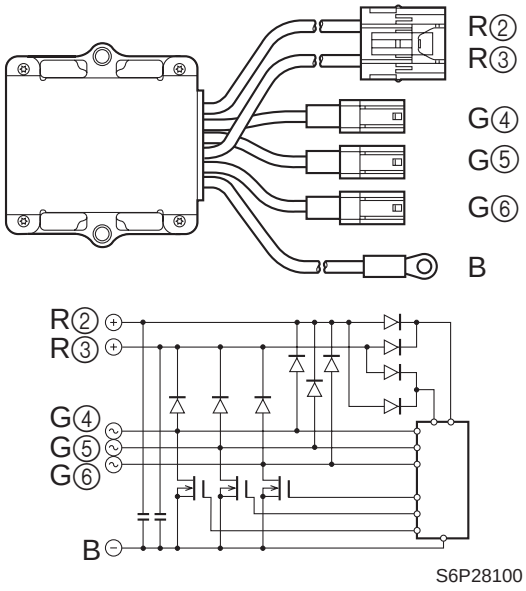


S6AL8370

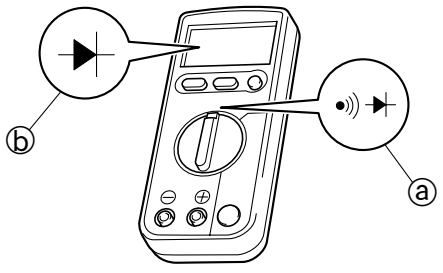
NOTE:
Do not use peak voltage adapter B when measuring the Rectifier Regulator output peak voltage.

Rectifier Regulator output peak voltage: Red (R) – Ground		
r/min	Unloaded	
	1,500	3,500
DC V	13.0	13.0

4. Check the Rectifier Regulator for continuity. Replace if out of specification.



S6P28100



S6S18360

NOTE:
Be sure to set the measurement range ⓐ, and display the mark ⓑ by pushing the "SHIFT" switch when checking the Rectifier Regulator continuity.

Rectifier Regulator continuity (testing diode)		
Tester lead		Display value (V)
⊕	⊖	
G ④	R ②	0.42–0.45 V (reference data)
G ④	R ③	
G ⑤	R ②	
G ⑤	R ③	
G ⑥	R ②	
G ⑥	R ③	
R ②	G ④	OL (over load)
R ②	G ⑤	
R ②	G ⑥	
R ③	G ④	
R ③	G ⑤	
R ③	G ⑥	

8

— MEMO —

Troubleshooting

YDIS 9-1
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Connecting the communication cable to the outboard motor 9-5

Troubleshooting the power unit 9-6
Troubleshooting the power unit using the YDIS 9-6
Trouble code and checking step 9-9
Troubleshooting the power unit using the diagnostic flash indicator 9-17
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Troubleshooting the PTT unit 9-24
Troubleshooting the lower unit 9-25

YDIS

Introduction

Feature

The newly developed YDIS provides quicker detection and analysis of engine malfunctions.
By connecting your computer to the ECM of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.
If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP, the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.
In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

Function

1. **Diagnosis:** Displays each part name, and the ECM trouble codes and status when the engine start switch is turned to "ON." This allows you to quickly specify malfunctioning parts. The trouble codes displayed are the same as those described in "Trouble code and checking step" in this chapter (9-9).

2. **Diagnosis record:** Displays each part name and the ECM trouble codes that have been registered. This allows you to check the outboard motor's record of malfunctions. The trouble codes displayed are the same as those described in "Trouble code and checking step" in this chapter (9-9).

3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly. In addition, the data displayed using the Engine Monitor function can be displayed in a graph.

Items: For F(L)200C, F(L)225B

1	Engine speed	10	Fuel injection duration	19	Dual engine system switch
2	Intake pressure(*1)	11	Ignition timing	20	Shift cut-off switch(*7)
3	Throttle position sensor 1	12	Engine temperature	21	Overheat thermoswitch(*8)
4	Throttle valve opening (0–90)	13	Intake temperature(*2)	22	Main switch(*9)
5	Throttle position sensor 2	14	Oil pressure(*3)	23	Main relay(*10)
6	Accelerator position sensor 1	15	Intake cam timing (STBD)(*4)	24	Electronic throttle relay(*11)
7	Accelerator position sensor 2	16	Intake cam timing (PORT)(*5)	25	Fuel pump relay(*12)
8	Atmospheric pressure	17	Engine stop lanyard switch		
9	Battery voltage (12–16)	18	Shift position switch(*6)		

(*1): Intake air pressure
(*2): Intake air temperature
(*3): Engine oil pressure
(*4): Intake cam timing (starboard)
(*5): Intake cam timing (port)
(*6): Neutral switch
(*7): Shift cut switch
(*8): Thermoswitch
(*9): Engine start switch
(*10): Main relay (ignition coil, fuel injector, variable camshaft timing, ECM, low-pressure fuel pump, high-pressure fuel pump)
(*11): Electronic throttle valve relay
(*12): High-pressure fuel pump relay

4. **Stationary test:** Operation tests can be performed with the engine off.

Items: For F(L)200C, F(L)225B

1	Ignite ignition coil (#1–#6)	3	Oil ctrl. valve drive (STBD)(*1)	5	Operate electric fuel pump(*3)
2	Operate injector (#1–#6)	4	Oil ctrl. valve drive (PORT)(*2)	6	Operate elect. fuel feed pump(*4)

(*1): Oil control valve drive (starboard)
(*2): Oil control valve drive (port)
(*3): Operate high-pressure fuel pump
(*4): Operate low-pressure fuel pump

5. **Data logger:** Displays 13 minutes of recorded data for 2 or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine. For the F(L)200C, F(L)225B models, you can also save the ECM record data on a file so that you can view and display the graph later.

Items: For F(L)200C, F(L)225B

1	Engine speed	3	Throttle position sensor	5	Intake pressure(*1)
2	Battery voltage (12–16)	4	Engine temperature	6	Oil pressure(*2)

(*1): Intake air pressure
(*2): Engine oil pressure

6. **ECM record data graph:** When a malfunction occurs in the electronic throttle valve system, 4 seconds (2 seconds before and after the malfunction) of recorded data are saved in the ECM. This data can be displayed on a graph using the “ECM record data graph” of the Data logger function.
When the communication cable is used to connect a computer to the ECM, the ECM record data can be saved and viewed on the computer.
The saved ECM record data can also be viewed offline.

Items: For F(L)200C, F(L)225B

1	Engine speed	8	Target TPS voltage(*4)	15	Engine stop lanyard switch
2	Accel position sensor 1(*1)	9	Ref. TPS voltage(*5)	16	Main relay(*9)
3	Accel position sensor 2(*2)	10	Ref. acc. pos. sensor voltage(*6)	17	Electronic throttle relay(*10)
4	Throttle position sensor 1	11	Target TPS voltage for ISC(*7)	18	Overheat warning
5	Throttle position sensor 2	12	Engine stop mode	19	Low oil pressure(*11)
6	Intake pressure(*3)	13	Engine start mode		
7	Battery voltage	14	Engine stop mode with SW(*8)		

(*1): Accelerator position sensor 1
(*2): Accelerator position sensor 2
(*3): Intake air pressure
(*4): Target TPS voltage
This item shows the target output voltage of the TPS.
This value is the control voltage that the ECM requires to set the target opening angle of the throttle valve.
(*5): Reference TPS voltage
This item shows the criterion output voltage of the TPS.
This value is used to detect the TPS output voltage during engine operation.
(*6): Reference accelerator position sensor voltage
This item shows the criterion output voltage of the accelerator position sensor.
This value is used to detect the accelerator position sensor output voltage when the remote control throttle lever is opened.
(*7): Target TPS voltage for Idle Speed Control
ECM controls the engine idle speed by using the throttle valve attached to the TPS.
This target voltage is used by the ECM to achieve the target opening angle of the throttle valve at the engine idle speed.
(*8): Engine stop mode with switch
(*9): Main relay (ignition coil, fuel injector, variable camshaft timing, ECM, low-pressure fuel pump, high-pressure fuel pump)
(*10): Electronic throttle valve relay
(*11): Low engine oil pressure

NOTE:
To display the displays and graphs, see the YDIS (Ver. 1.23a or later) Instruction Manual.

9

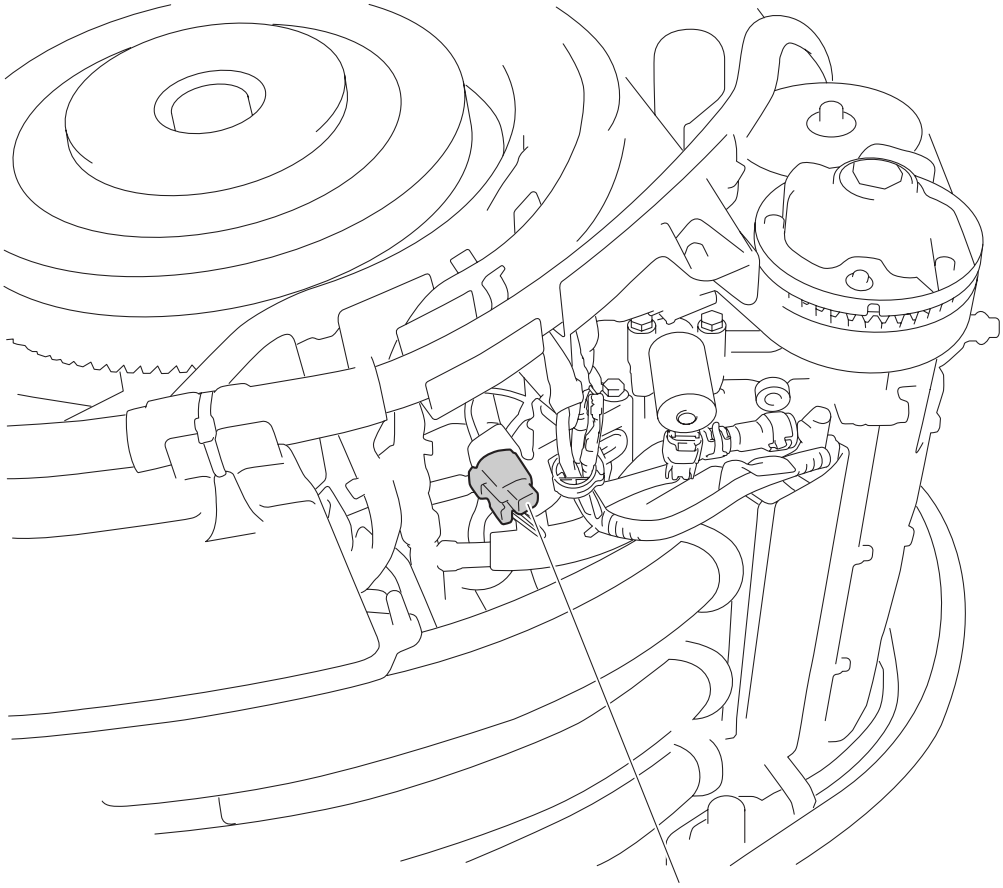
Contents

1. CD-ROM (software + instruction manual) (1)
2. Adapter (1)
3. Communication cable (1)



① ② ③

Connecting the communication cable to the outboard motor



3-pin communication coupler (gray)

S6P29010

Troubleshooting the power unit

NOTE:

- Before troubleshooting the outboard motor, make sure that fresh fuel of the specified type has been used.
- Check the trouble code using the YDIS (or diagnostic flash indicator B) first, and then check the electronic control system follow the trouble code chart.
- When a three-digit trouble code is detected, check the data logger of the ECM record data graph as well.
- It is recommended to use the YDIS for troubleshooting, it is not enough to check the electronic throttle valve system (electronic throttle valve, TPS, and accelerator position sensor) when only using diagnostic flash indicator B.
- If a trouble code is not detected, check the power unit according to “Troubleshooting the power unit (trouble code not detected).”
- Before using the YDIS or diagnostic flash indicator B to check the power unit, check the ECM circuit. To check the ECM circuit, see Chapter 8, “Checking the ECM circuit.”
- Be sure to check that the couplers and connectors are securely connected.
- When deleting the diagnosis record on the YDIS, be sure to check the time that the trouble codes were detected.
- When checking the input voltage of a part, the coupler or connector must be disconnected. As a result, the ECM determines that the part is disconnected and a trouble code is detected. Therefore, be sure to delete the diagnosis record after checking the input voltage.
- Since the main relay comes on for approximately 10 seconds after the start switch is turned to “OFF,” the power of the ECM cannot be turned off. Therefore, if the start switch is turned to “ON” within 10 seconds after it was turned to “OFF,” the trouble codes cannot be deleted.

Troubleshooting the power unit using the YDIS

NOTE:

- Use the trouble codes displayed by the YDIS to check each part according to the “Trouble code and checking step” table.
- Delete the trouble codes after checking, repairing, or replacing a part and check that the trouble codes are not detected again. If the same trouble codes are detected, the ECM may be faulty.
- Check the items listed in the table, if all the items are in good condition delete the trouble code, and then check the trouble codes again. If the same trouble codes are detected again, the ECM is faulty.
- A breakdown of the engine symptoms are described in the table below, however, multiple malfunctions that have been duplicated cannot be limited to these items. The symptoms may change according to the operating conditions and other conditions.

Trouble code table

Code No.	Item	Diagnostic flash indicator B code output	Diagnosis code output (YDIS Ver. 1.23a)	Diagnosis record (YDIS Ver. 1.23a)
1	Normal	○	—	—
13	Pulser coil malfunction	○	○	○
15	Engine temp sensor malfunction	○	○	○
17	Knock sensor malfunction	○	○	○
19	Battery voltage malfunction	○	○	○
23	Intake temp sensor malfunction	○	○	○
24	Cam position sensor (EXH) malfunction	○	○	○
28	Shift position switch malfunction	○	○	○
29	Intake press sensor malfunction	○	○	○
37	Intake air passage malfunction	○	○	○
39	Oil press sensor malfunction	○	○	○
44	Engine stop lanyard switch malfunction	○	○	—
45	Shift cut-off switch malfunction	○	○	○
46	Overheat thermoswitch malfunction	○	○	○
71	Cam position sensor (STBD INT) malfunction	○	○	○
72	Cam position sensor (PORT INT) malfunction	○	○	○
73	Oil control valve (STBD)	○	○	○
74	Oil control valve (PORT)	○	○	○
112, 113, 114, 115, 116, 117, 118, 119, 121, 122, 123, 129, 136, 137, 138, 139, 141, 142, 143, 144, 145	Electronic throttle system malfunction	○	○	○
124, 125, 126, 127, 128	Throttle position sensor malfunction	○	○	○
131, 132, 133, 134, 135	Accelerator position sensor malfunction	○	○	○

Symptoms table

Engine startability	Engine idle speed	Maximum engine speed	Acceleration	Symptom
Starts	Normal(*1)	Normal(*2)	Normal(*4)	A
		Decreases(*3)	Poor(*5)	B
	Increases (steady)	Normal	Normal	C
			Poor	D
		Decreases	Normal	E
			Poor	F
	Increases (unsteady)	Normal	Normal	G
		Down	Poor	H
	Unsteady	Down	Poor	I
	Increases(*6)	1,200–1,500 r/min	Impossible	J
Does not starts	Engine does not operate			K

(*1): 600–700 r/min at engine idle speed
(*2): 5,000–6,000 r/min
(*3): Less than the specified engine speed
(*4): Engine speed increases according to throttle opening angle
(*5): Engine speed does not increase according to throttle opening angle
(*6): Limp home processing

Trouble code and checking step

Trouble code	Item	Symptom	Symptom Remarks	Checking steps	Refer to page
13	Pulser coil(*1) malfunction	H	Trolling speed is unstable	1. Measure the crank position sensor resistance.	8-18
				2. Check the white/black (W/B) lead and black (B) lead (ECM-to-crank position sensor) for continuity.	WD
				3. Measure the crank position sensor output peak voltage.	8-18
				4. Measure the crank position sensor air gap.	8-19
				5. Check the projections of the flywheel magnet for damage.	5-6
15	Engine temp sensor(*2) malfunction	D	—	1. Check the engine temperature using the YDIS.	9-1
				2. Measure the input voltage.	8-21
				3. Measure the resistance.	8-21
17	Knock sensor malfunction	C	Maximum power decreases	1. Measure the resistance.	8-25
				2. Check the green (G) lead (ECM-to-knock sensor) for continuity.	WD
19	Battery voltage malfunction	C	—	1. Check the battery voltage using the YDIS.	9-1
				2. Measure the Rectifier Regulator output peak voltage.	8-51
				3. Measure the stator coil output peak voltage.	8-50
				4. Check the fuse.	8-5
				5. Check the battery cables and terminals for proper connection.	3-17
23	Intake temp sensor(*3) malfunction	C	—	1. Check the intake air temperature using the YDIS.	9-1
				2. Measure the input voltage.	8-20
				3. Measure the resistance.	8-20

(*1): Crank position sensor
(*2): Engine temperature sensor
(*3): Intake air temperature sensor
WD: See the wiring diagram.

Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
24	Cam position sensor (EXH)(*1) malfunction	D	—	1. Check the cam timing using the YDIS.	9-1
				2. Measure the input voltage.	8-34
				3. Check the white/blue (W/L) lead (cam position sensor-to-ECM) for continuity.	WD
				4. Measure the output voltage.	8-34
				5. Check the brim of the camshaft.	5-25
28	Shift position switch(*2) malfunction	A	—	1. Check the switch operation using the YDIS.	9-1
				2. Check the switch continuity.	8-24
				3. Measure the input voltage.	8-24
				4. Check the shift bushing and shift mechanism.	7-1
29	Intake press sensor(*3) malfunction	C	Maximum power decreases	1. Check the intake air pressure using the YDIS.	9-1
				2. Check the vacuum hoses.	4-2
				3. Measure the input voltage.	8-21
				4. Check the operation of the intake air pressure sensor.	8-21
				5. Check the pink/green (P/G) lead (ECM-to-sub wiring harness-to-intake air pressure sensor) for continuity.	WD
37	Intake air passage malfunction	G	Trolling speed is unstable	1. Check the O-rings and gaskets of the intake manifold, surge tank, and throttle body.	4-9 4-13
				2. Check the hose between the vapor shut-off valve and surge tank.	4-2
				3. Check the throttle valve condition.	8-26
				4. Check the intake air pressure sensor hose.	4-2
				5. Check the pressure regulator hose.	4-2

(*1): Cam position sensor (port exhaust)
(*2): Neutral switch
(*3): Intake air pressure sensor
WD: See the wiring diagram.

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Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
39	Oil press sensor(*1) malfunction	C	—	1. Check the engine oil pressure using the YDIS.	9-1
				2. Measure the input voltage.	5-2
				3. Measure the output voltage.	5-2
				4. Check the pink/white (P/W) lead (ECM-to-oil pressure sensor) for continuity.	WD
				5. Measure the engine oil pressure using an oil pressure gauge.	5-1
44	Engine stop lanyard switch malfunction	K	Engine stalls (when running engine) Buzzer comes on	1. Check the switch operation using the YDIS.	9-1
				2. Check the clip.	8-26
				3. Check the switch continuity.	8-26
				4. Check the white (W) lead (ECM-to-10-pin main harness coupler) for continuity.	WD
				5. Check the black (B) lead (10-pin main harness coupler-to-joint connector-to-ground) for continuity.	WD
45	Shift cut-off switch(*2) malfunction	C	Shifting to neutral is difficult	1. Check the switch operation using the YDIS.	9-1
				2. Check the switch continuity and resistance.	8-23
				3. Measure the input voltage.	8-23
				4. Check the shift bracket and shift mechanism.	7-1
46	Overheat thermoswitch(*3) malfunction	C	—	1. Check the switch condition using the YDIS.	9-1
				2. Measure the input voltage.	8-22
				3. Check the switch continuity.	8-22
				4. Check the engine temperature sensor.	8-22

(*1): Oil pressure sensor
(*2): Shift cut switch
(*3): Thermoswitch
WD: See the wiring diagram.

Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
71	Cam position sensor (STBD INT)(*1) malfunction	D	—	1. Check the cam timing using the YDIS.	9-1
				2. Measure the input voltage.	8-34
				3. Check the white/black (W/B) lead (cam position sensor-to-ECM) for continuity.	WD
				4. Measure the output voltage.	8-34
				5. Check the brim of the camshaft.	5-25
				6. Check the battery cables and terminals for proper connection.	3-17
72	Cam position sensor (PORT INT)(*2) malfunction	D	—	1. Check the cam timing using the YDIS.	9-1
				2. Measure the input voltage.	8-34
				3. Check the white/green (W/G) lead (cam position sensor-to-ECM) for continuity.	WD
				4. Measure the output voltage.	8-34
				5. Check the brim of the camshaft.	5-25
				6. Check the battery cables and terminals for proper connection.	3-17
73	Oil control valve (STBD)	D	—	1. Check the valve operation using the YDIS.	9-1
				2. Measure the resistance.	8-36
				3. Measure the input voltage.	8-36
74	Oil control valve (PORT)			4. Check the purple (Pu) lead (oil control valve-to-ECM) for continuity.	WD
				5. Check the filter and plunger.	8-36

(*1): Cam position sensor (starboard intake)
(*2): Cam position sensor (port intake)
WD: See the wiring diagram.

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Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
112 114	Electronic throttle system malfunction	J	—	1. Check the ECM circuit.	8-27
				2. Check the electronic throttle valve circuit.	8-33
				3. Check the electronic throttle valve relay and fuse.	8-27
113	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve operation.	8-26
				2. Check the TPS output voltage using the YDIS.	8-31
				3. Check the throttle opening angle using the YDIS.	8-31
				4. Check the ECM circuit.	8-27
				5. Check the electronic throttle valve circuit.	8-33
				6. Check the electronic throttle valve relay and fuse.	8-27
				7. Check the electronic throttle valve motor continuity.	8-31
115 116	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve circuit.	8-33
				2. Check the electronic throttle valve relay and fuse.	8-27
				3. Check the electronic throttle valve motor continuity.	8-31
117 118	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve circuit.	8-33
				2. Check the electronic throttle valve relay and fuse.	8-27
				3. Check the electronic throttle valve motor continuity.	8-31
119	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve circuit.	8-33
121	Electronic throttle system malfunction	J	—	1. Replace the ECM.	5-38
122	Electronic throttle system malfunction	J	—	1. Replace the electronic throttle valve assembly (electronic throttle valve motor malfunction).	4-13

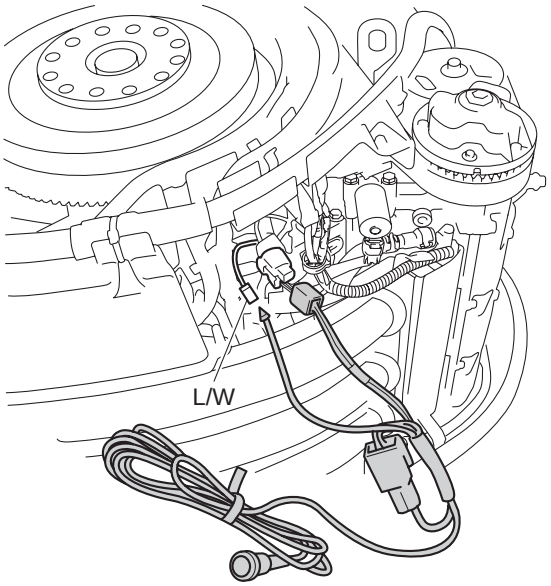
Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
123	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve relay and fuse.	8-27
				2. Check the electronic throttle valve circuit.	8-33
				3. Check the electronic throttle valve motor continuity.	8-31
124 125	Throttle position sensor malfunction	I	—	1. Check the TPS output voltage using the YDIS.	8-31
				2. Check the throttle opening angle using the YDIS.	8-31
				3. Check the electronic throttle valve circuit.	8-33
124 125 126 127 128	Throttle position sensor malfunction	J	—	1. Check the TPS output voltage using the YDIS.	8-31
				2. Check the throttle opening angle using the YDIS.	8-31
				3. Check the electronic throttle valve circuit.	8-33
127 128	Throttle position sensor malfunction	B	—	1. Check the TPS output voltage using the YDIS.	8-31
				2. Check the throttle opening angle using the YDIS.	8-31
				3. Check the electronic throttle valve circuit.	8-33
129	Electronic throttle system malfunction	B	—	1. Check the TPS output voltage using the YDIS.	8-31
				2. Check the throttle opening angle using the YDIS.	8-31
				3. Check the electronic throttle valve circuit.	8-33
129	Electronic throttle system malfunction	J	—	1. Check the TPS output voltage using the YDIS.	8-31
				2. Check the throttle opening angle using the YDIS.	8-31
				3. Check the electronic throttle valve circuit.	8-33

Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
131 132	Accelerator position sensor malfunction	B	—	1. Check the accelerator position sensor output voltage using the YDIS.	8-29
				2. Check the accelerator position sensor circuit.	8-31
				3. Measure the accelerator position sensor resistance.	8-29
131 132 133 134	Accelerator position sensor malfunction	J	—	1. Check the accelerator position sensor output voltage using the YDIS.	8-29
				2. Check the accelerator position sensor circuit.	8-31
				3. Measure the accelerator position sensor resistance.	8-29
133 134	Accelerator position sensor malfunction	B	—	1. Check the accelerator position sensor output voltage using the YDIS.	8-29
				2. Check the accelerator position sensor circuit.	8-31
				3. Measure the accelerator position sensor resistance.	8-29
135	Accelerator position sensor malfunction	B	—	1. Check the accelerator position sensor output voltage using the YDIS.	8-29
				2. Check the accelerator position sensor circuit.	8-31
				3. Measure the accelerator position sensor resistance.	8-29
136 137	Electronic throttle system malfunction	J	—	1. Check the ECM circuit.	8-27
				2. Check the electronic throttle valve relay and fuse.	8-27
				3. Check the electronic throttle valve circuit.	8-33
138 139	Electronic throttle system malfunction	J	—	1. Check the battery cables and terminals for proper connection.	3-17
				2. Check the ECM circuit.	8-27
				3. Check the electronic throttle valve circuit.	8-33
				4. Check the electronic throttle valve relay and fuse.	8-27

Trouble code	Item	Symptom	Remarks	Checking steps	Refer to page
141	Electronic throttle system malfunction	J	—	1. Check the battery cables and terminals for proper connection.	3-17
				2. Check the ECM circuit.	8-27
				3. Check the electronic throttle valve circuit.	8-33
				4. Check the electronic throttle valve relay and fuse.	8-27
142	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve operation.	8-26
143 144	Electronic throttle system malfunction	J	—	1. Check the battery cables and terminals for proper connection.	3-17
				2. Check the ECM circuit.	8-27
				3. Check the electronic throttle valve circuit.	8-33
				4. Check the electronic throttle valve relay and fuse.	8-27
145	Electronic throttle system malfunction	J	—	1. Check the electronic throttle valve operation.	8-26

Troubleshooting the power unit using the diagnostic flash indicator

1. Connect the special service tool to the outboard motor as shown.



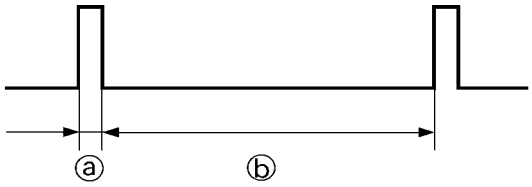
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NOTE:
When performing this diagnosis, all of the electrical wires must be properly connected.

Diagnostic flash indicator B:
90890-06865

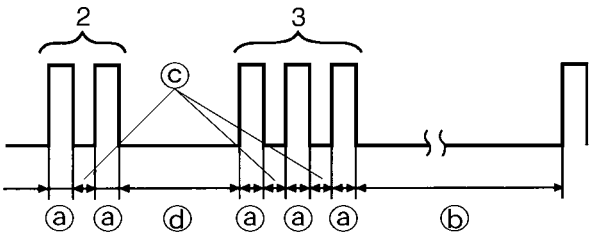
2. Start the engine and let it idle.

3. Check the flash pattern of the special service tool to determine.
   - Trouble code indication
     Example: Normal condition
     (no defective part or irregular processing is found)
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds

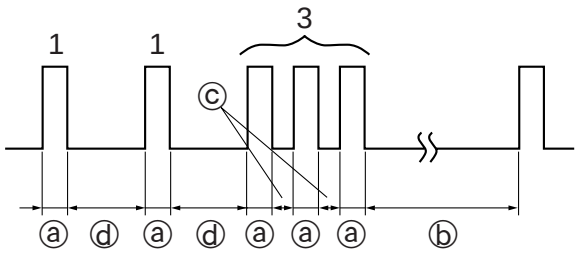


S6D79010

   - Trouble code indication
     Example: The illustration indicates code numbers 23 and 113.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds
     ⓒ: Light off, 0.33 second
     ⓓ: Light off, 1.65 seconds



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S6P29040E

4. If a flash pattern listed in the trouble code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:

- When more than one problem is detected, the light of the special service tool flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.
- If a trouble code is detected, see Chapter 9, “Trouble code and checking step.”

Troubleshooting the power unit (trouble code not detected)

Troubleshooting when a trouble code is not available consists of the following 4 items.
Symptom 1: Specific trouble conditions
Symptom 2: Trouble conditions of an area or individual part
Cause 1: The content considered as the trouble factors of symptom 2.
Cause 2: The content considered as the trouble causes of cause 1 (described if necessary).

Symptom 1: Engine does not crank

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Starter motor does not operate	Discharged battery	—	Check the battery.	3-17
	Loose connection of battery terminal	—	Check the battery terminal.	3-17
	Short, open, or loose connection in starter motor circuit	—	Check the wiring harness continuity.	WD
	Starter relay malfunction	—	Check the starter relay.	8-41
	Blown fuse	—	Check the fuse.	8-5
	Starter motor malfunction	—	Disassemble and check the starter motor.	8-42
	Engine start switch malfunction	—	Check the engine start switch.	8-25
	Gear shift not in the neutral position	—	Shift the remote control lever to the neutral position.	1-24
Starter motor operates, but the engine does not crank	Stuck piston	—	Disassemble and check the power unit.	5-1
	Piston lock due to water or oil in the combustion chamber			
	Salt buildup on the drive shaft and bushing	—	Disassemble and check the upper case.	7-10
	Starter motor malfunction	—	Disassemble and check the starter motor.	8-42

WD: See the wiring diagram.

Symptom 1: Engine will not start (engine cranks)

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
ECM does not operate	Relay malfunction	—	Check the relay.	8-27
	Blown fuse	—	Check the fuse.	8-5
	Short, open, or loose connection in ECM circuit	—	Check the ECM circuit.	8-27
	Engine start switch malfunction	—	Check the engine start switch.	8-25
Spark plug does not spark (all cylinders)	Crank position sensor malfunction and cam position sensor (PORT EX) malfunction	—	Check the crank position sensor and cam position sensor.	8-18 8-34
	Short, open, or loose connection in ignition coil ground circuit	—	Check the wiring harness continuity.	WD
Fuel not supplied (all cylinders)	High-pressure fuel pump does not operate	Short, open, or loose connection in high-pressure fuel pump circuit	Check the wiring harness continuity.	WD
		Blown fuse	Check the fuse.	8-5
		Relay malfunction	Check the relay.	8-39
		High-pressure fuel pump malfunction	Check the high-pressure fuel pump continuity.	8-39
	Low-pressure fuel pump does not operate	Short, open, or loose connection in low-pressure fuel pump circuit	Check the wiring harness continuity.	WD
		Blown fuse	Check the fuse.	8-5
		Low-pressure fuel pump malfunction	Check the low-pressure fuel pump continuity.	8-39
	Fuel not supplied to the fuel rails	—	Measure the fuel pressure.	4-6
Vapor shut-off valve does not close	Fixed vapor shut-off valve	—	Check the vapor shut-off valve.	8-40

WD: See the wiring diagram.

Symptom 1: Unstable engine idle speed, poor acceleration, poor performance, or limited engine speed

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Spark plug does not spark (some cylinders)	Spark plug malfunction	—	Check the ignition spark. Check the spark plugs.	3-8 8-18
	Short, open, or loose connection in ignition coil circuit	—	Check the wiring harness continuity.	WD
	Ignition coil malfunction	—	Change the ignition coil and check the ignition spark.	8-18
	ECM malfunction	—	Change the ignition coil and check the ignition spark.	8-18
High-pressure fuel line malfunction (fuel pressure is low)	Pressure regulator malfunction	—	Check the pressure regulator.	4-7
	High-pressure fuel pump malfunction	—	Check the high-pressure fuel pump continuity.	8-39
Fuel not supplied (some cylinders)	Fuel injector malfunction	—	Check the fuel injector operation. Measure the fuel injector resistance.	8-38
	Short, open, or loose connection in fuel injector circuit	—	Check the wiring harness continuity.	WD
	ECM malfunction	—	Change the fuel injector and check the fuel injector operation.	4-23 8-38
	Clogged fuel injector filter	—	Replace the fuel injector.	4-23
Low compression pressure	Scratched piston	—	Measure the compression pressure. Disassemble and check the power unit.	5-1
	Damaged valve			
	Valve stuck to valve guide			

WD: See the wiring diagram.

Symptom 1: High engine idle speed (below 1,200 r/min)

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Air leakage (throttle valve-cylinder head)	—	Check the O-rings and gaskets of the intake manifold, surge tank, and throttle body.	4-9 4-13

Symptom 1: Engine stalls, unstable engine idle speed, or poor acceleration

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Incorrect intake cam timing (check using the YDIS)	Variable camshaft timing operation malfunction	Stuck oil control valve plunger	Check the oil control valve operation using the YDIS. Check the oil control valve plunger.	8-36 9-1
		Clogged oil control valve filter	Replace the oil control valve filter.	5-43
		Clogged oil passage	Check the oil passage.	5-1
		Stuck variable camshaft timing	Replace the variable camshaft timing.	5-7

Symptom 1: Limited engine speed (below 2,000 r/min)

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
• Buzzer comes on • Overheat warning indicator comes on • Cooling water does not discharge from the cooling water pilot hole	Clogged cooling water inlet	—	Check the cooling water inlet.	3-10
	Water pump malfunction	Water pump impeller malfunction	Check the impeller.	6-5 6-34
			Check the Woodruff key.	6-5 6-34
		Water leakage from water pump housing	Check the water pump housing.	6-5 6-34
			Check the insert cartridge.	6-5 6-34
			Check the outer plate cartridge.	6-5 6-34
	Clogged cooling water passage	—	Check the cooling water passage (power unit, exhaust guide, and upper case).	3-10
	Thermostat malfunction	—	Check the thermostat.	3-9
• Buzzer comes on • Oil pressure warning indicator comes on	Insufficient engine oil	—	Add sufficient oil.	3-5
	Engine oil pressure decrease	Oil pump malfunction	Check the oil pump.	5-73
		Clogged oil strainer	Check the oil strainer.	7-16
		Clogged oil passage	Check the engine oil passage (power unit and oil pump).	5-2
		Clogged oil filter	Replace the oil filter.	3-7

Troubleshooting the PTT unit

Symptom 1: PTT unit does not operate

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
PTT relay does not operate	PTT switch malfunction	—	Check the PTT switch.	7-59
	Short, open, or loose connection of the wiring harness	—	Check the wiring harness continuity.	WD
	PTT relay malfunction	—	Check the PTT relay.	7-58
PTT motor does not operate	Short, open, or loose connection of the PTT motor lead	—	Check the PTT motor lead.	7-36
	PTT motor malfunction	—	Disassemble and check the PTT motor.	7-35
	Blown fuse	—	Check the fuse.	8-5
	Loose connection of the battery terminal	—	Check the battery terminal.	3-17
	Discharged battery	—	Check the battery.	3-17
Oil pressure does not increase	Manual valve opened	Manual valve malfunction	Check the manual valve.	7-30
	Insufficient PTT fluid	—	Add sufficient fluid.	3-13
	PTT fluid leakage	—	Check the PTT unit for leakage.	7-30
	Clogged filter	—	Disassemble and check the PTT unit.	7-30
	Clogged fluid passage			

WD: See the wiring diagram.

Symptom 1: PTT unit does not hold the outboard motor up

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Manual valve opened	Manual valve malfunction	Check the manual valve.	7-30
	Insufficient PTT fluid	—	Add sufficient fluid.	3-13
	PTT fluid leakage	—	Check the PTT unit for leakage.	7-30
	Clogged fluid passage	—	Disassemble and check the PTT unit.	7-30

Troubleshooting the lower unit

Symptom 1: Shift mechanism of the forward gear and reverse gear does not operate properly

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Remote control box malfunction	—	Check the remote control box.	1-24
	Shift cable and shift cable end malfunction	—	Check the shift cable and shift cable end.	3-12
			Adjust the shift cable.	3-12
	Shift rod operation malfunction	Detent malfunction	Check the detent.	7-1
		Shift rod connection malfunction	Check the shift rod connection.	6-5 6-34
	Shift mechanism malfunction (in lower unit)	—	Check the internal parts of the lower unit.	6-1 6-31

A.

Abbreviation 1-3
Accelerator position sensor 4-12
Adjusting the throttle cable 3-11
Adjusting the trim sensor 7-28
Adjusting the valve clearance 5-11
Aft view 8-6, 8-13
After test run 1-25
Assembling the bottom cowling 7-7
Assembling the drive shaft housing 6-16, 6-47
Assembling the forward gear 6-16
Assembling the gear pump 7-44
Assembling the lower case 6-15, 6-46
Assembling the oil pan and exhaust manifold 7-16
Assembling the oil pump 5-73
Assembling the power unit 5-69
Assembling the propeller shaft assembly ... 6-9
Assembling the propeller shaft housing 6-10, 6-39
Assembling the PTT motor 7-38
Assembling the reverse gear 6-46
Assembling the shift bracket 7-6
Assembling the starter motor 8-48
Assembling the tilt ram 7-51
Assembling the trim ram 7-53
Assembling the upper case 7-18

B.

Backlash (counter rotation model) 6-60
Backlash (regular rotation model) 6-28
Bleeding the PTT unit 7-56
Bleeding the PTT unit (built-in) 7-57
Bottom cowling 8-15
Bracket unit 3-13
Break-in 1-25

C.

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Changing the engine oil (draining) 3-6
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Wiring diagram
Grey Whale 200 - Fin Whale 225

① Condenser
(connect to the intake air pressure sensor)
② PTT switch
③ Trim sensor
④ Crank position sensor
⑤ Stator coil
⑥ Starter motor
⑦ Battery
⑧ Accessory battery
⑨ PTT motor
⑩ Rectifier Regulator
⑪ PTT relay
⑫ Fuse box
⑬ Diode (connect to the PTT relay)
⑭ Oil pressure sensor
⑮ Shift cut switch
⑯ Neutral switch
⑰ Accelerator position sensor
⑱ Fuel injector
⑲ Thermoswitch (STBD)
⑳ Oil control valve (STBD)
㉑ Knock sensor
㉒ Cam position sensor (STBD IN)
㉓ Ignition coil
㉔ Spark plug
㉕ ECM
㉖ Cam position sensor (PORT IN)
㉗ Cam position sensor (PORT EX)
㉘ Engine temperature sensor
㉙ Oil control valve (PORT)
㉚ Thermoswitch (PORT)
㉛ High-pressure fuel pump
㉜ Low-pressure fuel pump
㉝ Intake air temperature sensor
㉞ Electronic throttle valve assembly
㉟ Vapor shut-off valve
㊱ Intake air pressure sensor
㊲ Condenser (connect to the cam position sensor (PORT EX))
㊳ Water detection switch (in fuel filter)
㊴ LAN communication coupler

Ⓐ To remote control/switch panel
Ⓑ To warning indicator/trim meter
Ⓒ To diagnostic test lead (special service tool)
Ⓓ To personal computer for diagnosis
Ⓔ To cooling water pressure sensor (optional)
Ⓕ To speed sensor (optional)
Ⓖ To trim meter
Ⓗ To 6Y8 Multifunction Meter

(*1) Isolator cable (optional)
(*2) Negative battery cable
(commercially available)
(*3) The 6Y8 Multifunction Meter is a meter designed to be used in a local area network (LAN).

Color code

B : Black
Br : Brown
G : Green
L : Blue
Lg : Light green
O : Orange
P : Pink
R : Red
Sb : Sky blue
W : White
Y : Yellow
B/R : Black/red
B/W : Black/white
B/Y : Black/yellow
Br/W : Brown/white
G/B : Green/black
G/R : Green/red
G/Y : Green/yellow
L/G : Blue/green
L/W : Blue/white
L/Y : Blue/yellow
O/W : Orange/white
P/B : Pink/black
P/G : Pink/green
P/W : Pink/white
Pu/B : Purple/black
Pu/R : Purple/red
R/B : Red/black
R/Y : Red/yellow
W/B : White/black
W/L : White/blue
W/R : White/red

NOTE:
Depending on the outboard motor, the location of the coupler terminal may be changed as indicated in the table below.

Coupler	Terminal No.	Color
Ⓕ (on the wiring harness guide)	2 through 18 (except 13)	B
Ⓕ (on the ECM bracket)	1 through 12	B
	14 through 17	R/Y
	20 through 24	O
Ⓤ	1 and 8	R/Y
Ⓦ	16, 17, 23, 24, and 32	B
	27 and 28	R/Y
Ⓧ	1 through 22 (except 11 through 15)	R/Y
Ⓨ	3 and 4	R
	11 and 12	R/G

Grey Whale 200 - Fin Whale 225

